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Transforming agriculture – between policy, science and the consumer

Proceedings – Volume 2

Warsaw University of Life Sciences – SGGW

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I.
PEER REVIEWED PAPERS

NORTH AMERICAN FARMLAND INVESTMENT PERFORMANCE ASSESSMENT USING E-V ANALYSIS, CAPM AND VALUE AT RISK

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Abstract

Why is there a strong and growing demand for farmland investment from the non-agricultural sector? Over the study period 1972-2011, North American farmland investment yields have been very competitive with stocks, bonds and real estate. In this study, three methods are used to assess the investment performance of farmland within a diversified portfolio: the Capital Asset Pricing Model (CAPM), the Expected Value-Variance Model (E-V Analysis), and the Value at Risk (VAR) Model. The CAPM analysis suggests that farmland provides an investment yield that is greater than required, given that it adds little or no risk to a diversified portfolio. This also implies that farmland, given its competitive yield, can enhance investment performance in a diversified portfolio. Since CAPM is an equilibrium pricing model, it further suggests that farmland is underpriced and in a liquid, free trading market place, farmland prices would be bid up until the excess return disappears. The E-V analysis found that a North American farmland investment can improve the investment performance of the efficient set of portfolios at low and medium risk levels, but does not provide improvement for higher risk portfolios. Finally, the VAR analysis found that when North American farmland is added to a diversified portfolio, it reduces the maximum expected loss that can occur, thereby reducing the downside risk of the portfolio without reducing the expected yield. In general, all three methods, CAPM, E-V analysis and VAR found consistent results; that North American farmland has a competitive yield and is very good at reducing risk in a diversified portfolio, thereby improving overall investment performance.

Keywords: North American Farmland Investment, CAPM, efficient investment

1. Introduction

The demand for North American farmland investment is significant and appears to be growing. This paper will look at Canadian and US farmland investment attributes to assess why the demand for farmland by the non-agricultural sector appears to be strong and growing. Specifically, the assessment will proceed in the following order:

1. North American farmland investment yields will be calculated for the period 1972-2011.
2. The variance-covariance and correlation matrices will be calculated for a set of investment assets including treasury bills (T-bills), government bonds, North American Farmland Trust, US Real Estate Investment Trusts (REITs), gold, oil and stock markets around the world.
3. The Capital Asset Pricing Model (CAPM) will be applied to all assets to assess asset prices and values relative to their levels of systematic risk. The CAPM will be used to assess the investment diversification attributes of farmland and compare farmland valuation relative to other investment assets.
4. The Markowitz E-V model will be used, with the inclusion of the risk-free asset, to determine efficient investment portfolios and the extent to which farmland is included in the ‘best’ portfolios.

5. Low, medium and high risk portfolios will be chosen from the E-V efficient set and will be compared using the Value at Risk methodology (VAR), to determine whether farmland has significant risk-reducing capabilities when added to an investment portfolio;
6. The CAPM, E-V and VAR results will be compared to make an overall assessment of North American farmland investment performance over the period 1972-2011.

2. Background

The idea of efficient investment is usually credited to Markowitz (1959), who developed the expected value-variance (E-V) model, which could combine the right assets in the right proportions to provide a portfolio that dominated all others, in term of return per unit of risk taken. Tobin (1958) and Treynor (1961) extended the E-V model by adding the risk-free asset. Their contribution, called the two-fund separation theorem, produced the Capital Market Line (CML). While E-V analysis and the CML focused on efficient portfolios, Sharpe (1964) developed the Capital Asset Pricing Model (CAPM), which looked at the investment attributes and pricing of individual assets. Value at Risk (VAR) is a risk management tool that was developed by finance and stock market professionals in the late 1980's. It is a model that can estimate for a portfolio the probability of a maximum loss to occur, for a specified period of time.

Peter Barry (1980) applied the CAPM to farmland in eleven different regions in the United States and found that farmland added very little risk to a diversified portfolio of stocks and bonds because most of farmland risk is diversifiable (unsystematic risk). Kaplan (1985) found that farm real estate had two favorable attributes: high total return and low correlation with other assets, which meant that including farmland in a portfolio added a high return asset with very little risk added. Moss, Featherstone and Baker (1987) as well as Lins, Kowalski and Hoffman (1992) and Ruebens and Webb (1995), assessed efficient portfolios using US financial assets and farmland and concluded that the addition of farmland to stock and bond portfolios improved portfolio performance. Brown (1999) showed that farm returns are comparable to returns for stocks and bonds and correlations are low between farmland and financial assets, indicating the potential for efficient diversification by adding farmland to the investment mix. Bigge and Langemeier (2004) found that Kansas farmland's low level of systematic risk meant that farmers could improve overall portfolio performance with investment in the stock market. Libbin, Kohler and Hawkes (2004a and 2004b) suggested that farmers could improve financial performance by investing in financial assets and/or paying down their debt liabilities. Hardin and Cheng (2005) used a Markowitz semi-variance model to evaluate US farmland in a mixed-asset portfolio and found that farmland did not need to be a substantial part of an optimal portfolio; however, they suggested that more studies were needed using additional farmland data to fully assess direct investment in agricultural land. Shadbolt and Gardner (2006) found that returns to farming business investors are highly variable compared to the returns to farmland ownership based on rental agreements. Oltmans (2007) explains that with an appreciating asset like farmland, the capital gain return means that the asset itself need produce less operating income to make it economically desirable. This in part explains why farmers continue to purchase farmland even when it cannot cash flow itself because the operating return is only part of the total return; capital gain (expected growth) is the other part and needs to be addressed in the valuation assessment as well. Painter and Eves (2008) assessed farmland investments in United States, Canada, New Zealand and Australia and found that the low and negative correlation of farmland yields with stocks and bonds made it a good candidate for portfolio diversification. Waggle and Johnson (2009) added farmland and timberland to the choice set of assets. They employed a Markowitz portfolio optimization model and found widely varying allocations with farmland entering the optimal portfolios only at low risk levels and timberland at higher risk levels. Painter (2011) found that a Canadian Farmland Real Estate Investment Trust fared well in an efficient international investment portfolio and provided better diversification performance than gold, in medium risk portfolios. Noland et. al. (2011), used the University of Illinois farmland portfolio and found that it frequently dominated the efficient asset allocation when other financial assets were included in the choice set.

3. Calculating income and capital gain yields for a North American FREIT

Farmland ownership yields are calculated annually for the 1972-2011 study period, for the following Canadian provinces and US states: in Canada, Alberta, Saskatchewan, Manitoba, Ontario and Quebec; in US, Iowa, Illinois, Nebraska, Minnesota and Kansas. In each province and state, aggregate farmland data is used to simulate an FREIT (farmland real estate investment trust), assuming that an FREIT will own land that is geographically dispersed for diversification reasons. The total return to an FREIT is divided into two parts; income return and capital gain return. The income return is based on the net lease revenue obtained from renting the farmland in the trust to farm operators. The capital gain return is the change from year to year in the market value of the land. A standard crop share approach is used where the FREIT receives a percentage of the gross revenues produced (17.5% is used for North America to approximate cash rents that are usually in the 5-7% of land values range). The FREIT is then responsible for paying property taxes and building depreciation to arrive at a net lease amount or income return to the FREIT. Hence, the annual income return per hectare to farmland ownership in an FREIT is calculated as follows:

$$IR_t = LR_t - PT_t - BD_t \tag{1}$$

Where:
IR_t = \$ income return to farmland per hectare in year t;
LR_t = gross lease revenue per hectare in year t (17.5% of Gross Farm Revenues);
PT_t = property taxes per hectare in year t;
BD_t = building depreciation per hectare in year t;
The annual income and capital gain yields for each FREIT are calculated as follows:

$$IY_t = \frac{R_t}{V_{t-1}} \tag{2}$$

Where:
IY_t = % income yield per hectare in year t;
IR_t = \$ income return to farmland per hectare in year t;
V_{t-1} = average farmland value per hectare in year t-1.

$$CGY_t = \frac{V_t - V_{t-1}}{V_{t-1}} \tag{3}$$

Where:
CGY_t = % capital gain yield per hectare in year t;
V_t, V_{t-1} = average farmland values per hectare in years t and t-1, respectively.

Annual income and capital gain yields are calculated for each province and state, for the period 1972-2011. The annual total investment yields for each provincial and state FREIT are the sum of the annual income and capital gain yields, calculated as follows:

$$ROI_t = \frac{R_t}{V_{t-1}} + \frac{V_t - V_{t-1}}{V_{t-1}} \quad (4)$$

The average annual NA FREIT yield for the study period is the arithmetic average of the provincial and state yields for that year, while the average annual NA FREIT yield over the complete study period is the geometric average of the annual NA FREIT yields, which represents the average annual compounded rate of return earned. In both Canada and US, bond interest is taxed differently than dividends and capital gains. To compare average yields, tax adjustments are made to account for these differences. Also, an FREIT requires management so a Management Expense Ratio (MER) must be included to account for management costs. The average tax adjustment factor is calculated as follows:

$$T = \frac{1-t_{\text{int}\,erest}}{1-t_{Dividend,G}} \quad (5)$$

Where:
T = the tax adjustment factor for average T-bill and Long Bond yields;
$t_{interest}$ = the average personal tax rate on interest income;
$t_{Dividend,CG}$ = the average personal tax rate on dividend and capital gain income.

Using average personal tax rates in Canada and US, the adjustment factor T is 72%. An MER of 4% has been subtracted from the calculated NA FREIT average yield to account for management expenses. Table 1 illustrates the average annual yields for the choice set of investment assets, which include all tax and MER adjustments. The average borrowing rate is based on the average annual prime lending rate plus 2%, adjusted by the interest tax factor. The standard deviation of annual yields over the study period is provided as the measure of total risk and the coefficient of variation (standard deviation divided by average yield) is provided as a comparative measure of risk per unit of yield.

Table 1. Average annual investment yields for T-bills, long bonds, NA FREIT, gold, oil, REITs and stock markets (1972 – 2011)

Investment asset	Total yield	Standard deviation	Coefficient of variation
T-Bills	4.8%	0.0%	N/A
Long Bonds	5.8%	3.0%	0.52
Borrowing	7.4%	0.0%	N/A
NA FREIT	6.5%	9.4%	1.45
REITs	9.5%	21.4%	2.25
Gold	9.6%	26.1%	2.72
Oil	8.3%	29.4%	3.54
Stock markets			
Canada	9.2%	22.5%	2.44
Australia	9.3%	27.1%	2.91
US	8.5%	18.2%	2.14
Japan	8.6%	33.5%	3.90
Europe	9.4%	22.4%	2.38
World	8.5%	18.5%	2.18
Hong Kong	13.2%	46.8%	3.55

4. Correlation results

Table 2 provides the correlation coefficients for the set of investment assets. Some important implications for risk diversification are:

- NA FREIT is negatively correlated with REITs and every stock market, making it a good diversifier in a portfolio of REITs and stocks. NA FREIT also has very low correlation with both T-bills and long bonds, which suggests it may be a good diversifier even with fixed-income assets.
- NA FREIT has a positive correlation with inflation, which suggests it is a good hedge against inflation.
- Both gold and oil are also negatively correlated with REITs and stock markets (in general) and may be as good as or better than NA FREIT as risk reducers in a portfolio.

Table 2. Correlation matrix for the investment assets (1972-2011)

	T-b	LTB	NA F	Gold	Oil	REIT	Can	Aus	US	Japan	Eur.	World	HK	Inflation
T-b	1.0	.94	.01	-.13	.00	.02	-.12	-.13	.10	.07	.02	.06	-.01	.72
LTB		1.0	-.09	-.13	-.10	.10	-.13	-.10	.13	.16	.06	.12	.03	.69
NA FREIT			1.0	.46	.57	-.10	-.09	-.14	-.21	-.25	-.33	-.31	-.06	.48
Gold				1.0	.51	-.18	.10	.22	-.25	.09	-.13	-.11	.11	.26
Oil					1.0	-.21	-.03	-.25	-.35	-.29	-.36	-.41	-.14	.30
REIT						1.0	.47	.51	.57	.17	.39	.51	.43	.02
Can							1.0	.79	.66	.44	.64	.74	.60	-.13
Aus								1.0	.60	.45	.70	.77	.64	-.12
US									1.0	.35	.76	.88	.53	-.09
Japan										1.0	.47	.66	.59	.07
Europe											1.0	.89	.53	-.12
World												1.0	.64	-.08
HK													1.0	-.03

5. Capital Asset Pricing Model (CAPM) application

The second step in the analysis is to apply CAPM to the set of investment assets to assess diversification potential and pricing implications for each asset. For each asset, a beta is estimated using ordinary least squares regression, where the dependent variable is the individual asset annual excess yields[1] and the independent variable is the market portfolio annual excess yields, for the study period 1972-2011. The market portfolio chosen for this analysis is meant to represent a reasonable mix of investment assets that an average investor can choose from. The market portfolio proportions are; T-bills 5%, long bonds 20%, NA FREIT 5%, gold 5%, oil 5%, REITs 30%, and world stock market portfolio 30%. For the study period, the market portfolio average yield was 9.1% (average risk premium over the risk-free yield of 4.2%), with a standard deviation of 10%. Table 3 illustrates the resulting betas for each asset. Based on the CAPM results, there are some important considerations for portfolio diversification:

- NA FREIT, gold and oil all have zero or near zero betas implying that they add no risk to a diversified portfolio.

[1] Excess yields are determined by the actual yield minus the risk-free (T-bill) yield for that year.

Table 3. CAPM Betas for investment assets (1972-2011)

Asset	Beta (B_1)	B_1 t-value[a]	Intercept (B_0)	B_0 t-value
Long Bonds	0.03	1.75	0.8%	4.41
NA FREIT	0.00	0.03	2.1%	1.21
Gold	0.26	0.61	6.1%	1.31
Oil	-0.31	-0.66	8.7%	1.68
REITs	1.85	11.08	-1.8%	-0.99
Stock Markets:				
Canada	1.69	6.88	-1.3%	-0.46
Australia	2.10	7.48	-2.0%	-0.66
US	1.36	11.09	-1.8%	-0.99
Japan	1.42	2.93	1.4%	0.26
Europe	1.48	5.53	-0.2%	-0.05
World	1.47	8.29	-1.5%	-0.79
Hong Kong	2.92	5.02	3.3%	0.51

a The critical t-value for 10% error is 1.71.

- Since NA FREIT, gold, and oil add no risk to a diversified portfolio, their yields should be similar to the risk-free yield, however, all have produced greater yields than required by CAPM.
- CAPM is an equilibrium pricing model. It suggests that if an asset is offering a yield greater than its CAPM required yield, it is underpriced. Investors in the market will demand that asset for their portfolios and in the process, bid up the price until the excess yield is gone and it is offering its equilibrium CAPM required yield. The opposite should occur for an asset that is overpriced. The implication is that NA FREIT (as well as gold and oil) is underpriced[2]. This might suggest that if NA FREIT was widely available, liquid and marketable (i.e., trading on a stock exchange), it would be in demand, causing its price to rise, which in turn would cause FREIT managers to seek more farmland, causing farmland prices to rise.

6. Application of the Expected Value – Variance (E-V) Model

An E-V model was applied to the choice set of assets to determine optimal portfolios for the following three scenarios:

	Scenario	**Description**	**Asset Choices**
•	Scenario 1	Traditional Farmer Portfolio	Farmland (NA FREIT), bonds, stocks
•	Scenario 2	Traditional non-farmer Portfolio	Bonds, stocks, REITs
•	Scenario 3	No Restrictions on asset choice	All assets in choice set

The E-V model estimated optimal portfolios at all levels of risk and yield, for each of the three scenarios. The Capital Market Line for each scenario is illustrated in Figure 1.

2 It is important to note that CAPM has not been able to fully explain asset pricing, especially when it comes to low or zero beta assets. In fact, there are other low beta exchange-traded assets in different industries that exhibit persistent excess yields so there is no assurance that the farmland excess yields would disappear in a widely-traded market place.

Table 4 shows a comparison of the three scenarios, based on investment performance, at three levels of risk: low (6% yield), medium (8% yield) and high (10% yield). Based on the E-V analysis and results, some important considerations are as follows:

- At every risk level, unrestricted access to all assets (scenario 3) provides the most efficient portfolios.
- A traditional farmer portfolio, where most of the wealth is invested in farmland, appears to be a medium risk portfolio. A 100% farmland portfolio provides reasonably good investment performance but better performance could be achieved with the addition of other assets.
- Non-farmer investors could improve investment performance with the addition of NA FREIT at the low and medium risk levels, but does not appear to be a good choice for investors who want a higher risk portfolio.

Table 4. Three Scenario E-V Investment Performance Results for Low, Medium and High Risk Portfolios

	Scenario 1	Scenario 2	Scenario 3
Low risk			
Portfolio Yield	6.0%	6.0%	6.0%
Risk (Standard Deviation)	2.48%	2.95%	2.33%
Coefficient of Variation	0.41	0.49	0.39
Portfolio weights			
T-bills and Bonds	76.1%	90.2%	78.3%
NA FREIT	16.3%	0.0%	9.6%
Gold	0.0%	0.0%	2.8%
Oil	0.0%	0.0%	1.1%
REITs	0.0%	3.0%	3.0%
Stocks	7.6%	6.8%	5.2%
Medium risk			
Portfolio Yield	8.0%	8.0%	8.0%
Risk (Standard Deviation)	9.76%	10.82%	7.66%
Coefficient of Variation	1.22	1.35	0.96
Portfolio weights			
T-bills and Bonds	0.0%	44.7%	24.4%
NA FREIT	57.5%	0.0%	14.5%
Gold	0.0%	0.0%	13.8%
Oil	0.0%	0.0%	7.8%
REITs	0.0%	25.8%	17.7%
Stocks	42.5%	29.5%	21.8%
High risk			
Portfolio Yield	10.0%	10.0%	10.0%
Risk (Standard Deviation)	21.8%	20.15%	15.78%
Coefficient of Variation	2.18	2.02	1.58
Portfolio weights			
T-bills and Bonds	0.0%	0.0%	0.0%
NA FREIT	18.5%	0.0%	0.0%
Gold	0.0%	0.0%	29.9%
Oil	0.0%	0.0%	10.6%
REITs	0.0%	48.5%	32.5%
Stocks	81.5%	51.5%	27.0%

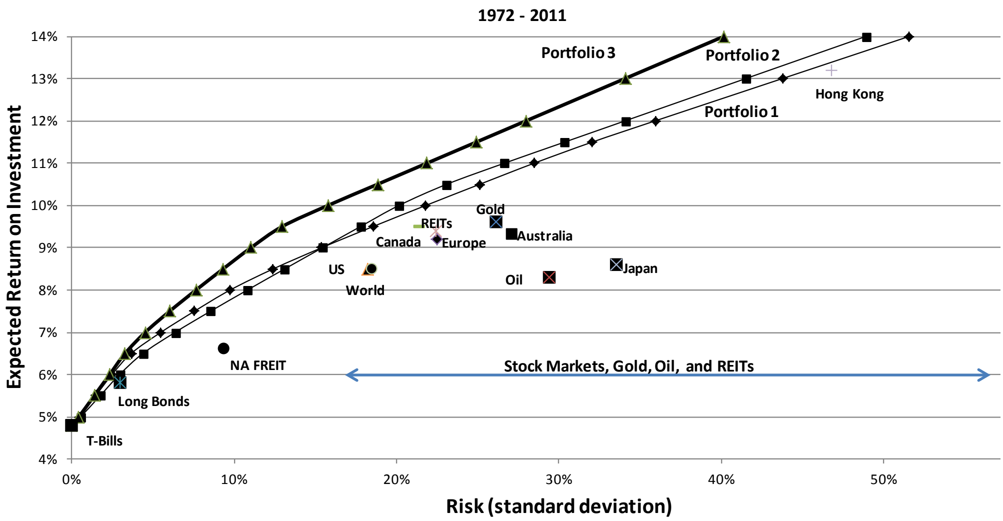

Figure 1. The Efficient Portfolios for Scenarios 1, 2 and 3 (1972-2011)

7. Value at Risk (VAR) Assessment

One of the advantages of using VAR to compare portfolios or assets on the basis of investment efficiency is that it need not require, as do both CAPM and E-V Analysis, that asset yields be normally distributed. Two VAR methods are employed: the historical method, where normality is not required, and the variance – covariance method, which assumes that yields are normally distributed.

VAR has three main components: a time period (in this study it is a year as annual yields are used), a confidence level (95%), and a loss amount (to be estimated). For each scenario and portfolio, the largest expected loss over the next year is estimated, given a 95% confidence level. Based on the past 40 years of yield experience, there is a 5% chance that the portfolio loss will be greater than the VAR estimate. For investors, this is meant to represent the lowest yield they can expect for the asset or portfolio, or the extent of the downside risk. Therefore, for a given expected yield, the asset or portfolio with the highest VAR (lowest loss) would be considered to have the lowest risk.

The three scenarios and portfolios from the E-V analysis are used to represent low, medium and high risk choices. For the historical method, the annual yields for each portfolio are calculated over the 40 year study period 1972-2011. The worst 5% of all yields for each portfolio (the left tail of the distribution) are observed and indicate the 95% confidence limit, or the extent to which losses can be expected 95% of the time. For the variance-covariance method, the portfolio yields are assumed to be normally distributed so the expected yield and standard deviation of the portfolio fully describe the distribution of yields. The 95% confidence lower limit is calculated as the average yield on the portfolio minus 1.96 x the standard deviation of the yields. Table 5 illustrates the VAR results for both methods.

In all cases, while the two VAR methods have different maximum loss results, the VAR (Historical) and the VAR (variance-covariance) provide consistent risk rankings amongst the scenarios and portfolios. Also, in the low and medium risk portfolios, the VAR and E-V risk rankings are the same. However, for the high risk portfolios, E-V analysis suggests that the scenario

Table 5. Three Scenario VAR Investment Performance Results for Low, Medium and High Risk Portfolios

	Scenario 1	Scenario 2	Scenario 3
Low risk			
Portfolio Yield	6.0%	6.0%	6.0%
Risk (Standard Deviation)	2.48%	2.95%	2.33%
Coefficient of Variation	0.41	0.49	0.39
VAR (Historical)	1.1%	-0.2%	1.4%
VAR (variance-covariance)	1.1%	0.2%	1.4%
Medium risk			
Portfolio Yield	8.0%	8.0%	8.0%
Risk (Standard Deviation)	9.76%	10.82%	7.66%
Coefficient of Variation	1.22	1.35	0.96
VAR (Historical)	-6.0%	-11.1%	-2.5%
VAR (variance-covariance)	-11.1%	-13.2%	-7.0%
High risk			
Portfolio Yield	10.0%	10.0%	10.0%
Risk (Standard Deviation)	21.8%	20.15%	15.78%
Coefficient of Variation	2.18	2.02	1.58
VAR (Historical)	-19.7%	-27.6%	-9.9%
VAR (variance-covariance)	-32.7%	-29.5%	-20.9%

1 portfolio is the least efficient at a 10% yield, as indicated by the coefficients of variation. The VAR (variance-covariance) method confirms that ranking but the VAR (Historical) method has the scenario 2 portfolio as the least efficient of the three in the high risk category. In general, the VAR results are consistent with the E-V results.

8. Summary and conclusions

Why is there a strong and growing demand for farmland investment from the non-agricultural sector? Over the study period 1972-2011, North American farmland investment yields have been very competitive with stocks, bonds and real estate. Since all investors hold a variety of assets in a portfolio, farmland is assessed in terms of the yield and risk that it adds to a diversified portfolio. Three methods are used to assess the investment performance of farmland within a diversified portfolio: the Capital Asset Pricing Model (CAPM), the Expected Value-Variance Model (E-V Analysis), and the Value at Risk (VAR) Model. The CAPM analysis suggests that farmland provides an investment yield that is greater than required, given that it adds little or no risk to a diversified portfolio. This also implies that farmland, given its competitive yield, can enhance investment performance in a diversified portfolio. The E-V analysis found that a North American farmland investment can improve investment performance at low and medium risk levels, but does not provide improvement for higher risk portfolios. Finally, the VAR analysis found that when North American farmland is added to a diversified portfolio, it reduces the maximum expected loss that can occur, thereby reducing the downside risk of the portfolio without reducing the expected yield. In general, all three methods, CAPM, E-V analysis and VAR found consistent results; that North American farmland has a competitive yield and is very good at reducing risk in a diversified portfolio, thereby improving overall investment performance.

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REALLOCATION OF PRICE RISK AMONG COOPERARTIVE MEMBERS

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Abstract

Currently there is practically no active output price hedging in the Danish livestock sector. This may be because their, until recently, was very little need for hedging, as Danish farmer had (a perception of) very large credit reserves up to the GFC. After the GFC the need for price risk management has increased, as an institutional vacuum has emerged, where no new risk coping mechanisms are in place after the credit reserves disappeared. Price hedging via futures may problematic when physical delivery is to a cooperative, as the cooperative specific business risk which is carried by the members, will translate into basis risk in a futures hedging arrangement. This paper explores the possibility of risk reallocation among cooperative members as an alternative risk management institution. Based on deduction and extension of a model by Collins (1997) it is found that given adequate member heterogeneity in the cost of carrying risk and given low enough transaction costs there are, potentially substantial, gains from reallocation of risk among cooperative members.

Keywords: futures, hedging, reallocation gains, risk management, cooperatives, mechanism design

1. Introduction

The main livestock sectors in Denmark, the hog and the dairy sectors, are characterized by asymmetry in the contracting behavior. On the input side, forward contracting and substantial self-sufficiency rates of grain or feed from the arable side of the farm are traditionally dominant. On the output side, there is tradition for the spot-price marketing of milk and meat delivered to cooperative dairies and slaughterhouses. This asymmetric behavior may be explained by related institutional domains such as agricultural policy, finance and organization. Recent changes in these domains suggest the need for adaptive changes in risk management institutions. However, this response may be very challenging and not automatic (Aoki, 2001).

According to Bogetoft and Olsen (2004), risk sharing between members in agricultural cooperatives is limited to risk sharing between producer product groups and risks the absorption of the equity buffer. This paper challenges this statement by suggesting the grouping of members according to their cost of carrying risk rather that their product attributes. By introducing mechanisms that reallocate risk from the individuals faced with a high cost of risk to individuals with a low cost of risk, the aggregate cost of risk can be reduced (Chavas, 2011).

Most research on hedging explores the vertical reallocation of risk in the value chain, the use of forward contracting, commodity futures and options being the main vehicles for the reallocation (Garcia and Leuthold, 2004). This paper explores the possibility of horizontal risk transfer among cooperative members. Endowing members with a forward contracted share of delivery, and organizing the transfer of this share via an auction mechanism at a market price will potentially lead to the reallocation gains.

2. Member heterogeneity in risk exposure, appetite and management needs

Recent work by Chavas (2011) stresses the interaction between uncertainty and externalities in efficiency analysis of the agricultural sector. Using a certainty equivalent approach, the Coasian efficiency evaluation is extended to include risk allocation. It is stated that "an efficient allocation should try to reduce the aggregate cost of risk" (Chavas, 2011, pp. 398) and three ways of doing this are mentioned. First, risk exposure can be reduced. Second, when exposure involves externalities, it can be managed by coordination schemes using contracts or policy. Third, "the aggregate cost of risk […] can be reduced through risk-transfer mechanisms. By redistributing the risk away from the individuals who face a high cost of risk […], such mechanisms can reduce the aggregate cost of risk" (Chavas, 2011, pp. 398-399). Chavas (2011) implicitly stresses the importance of heterogeneity and explicitly stresses the potential for reallocating risk.

Pennings and Leuthold (2000) and Pennings and Garcia (2004) explicitly stress the heterogeneity in hedging behavior using structural equation modeling to analyze the behavioral characteristics of Dutch hog farmers. The study shows heterogeneity in the drivers for the use of futures. In the USA, the use of price risk management is widespread in both the dairy and hog sectors and in Ireland the cooperative dairy Glanbia has forward contracted part of its production with members, linking member supply-side forward contracts to specific business partner contracts on the demand side (Keane, 2012). This illustrates demand for price risk management instruments in the dairy sector. Assuming heterogeneity in the attitude towards risk management instruments among hog and dairy farmers seems fair.

Collins (1997) presents a model where heterogeneity in cost structure, profitability and financial structure affect the likelihood of financial failure and motivate different levels of hedging via futures contracts.

3. The problem with futures markets – basis risk

Futures markets could potentially solve the problem of commodity price risk adjustment for the individual cooperative member. There may, however, be liquidity problems in existing futures markets for milk and pork. An even more fundamental problem is the substantial basis risk that emerges from the fact that even if futures markets could transfer market price risk effectively, farmers, as cooperative members, are exposed to business risk in the dairy or meat processing and marketing business. This is a broad definition of the basis risk concept, but a useful one. A narrow definition of basis risk is the difference between the spot cash price and the futures price (Hull, 2002).

The difference between futures market risk and the aggregate of cooperative business and market risk is a key element of the basis risk involved in synthetic futures based hedging. Information asymmetries about processing costs and marketing contract and risk management status between cooperatives and members make an effective hedge very difficult, if not impossible. The marketing cooperative may, however, not be very willing to disclose this information for strategic competition related reasons.

The pricing behavior of cooperatives may be affected by investment and finance considerations. The members are the residual claimants, but residual earnings may be retained in the cooperative for investment purposes or for reduction of debt. Thus strategic considerations concerning finance and possible credit constraints, as well as variation in investment opportunities for the cooperative, will affect the aggregate of the cooperative spot cash price and the end of year patronage payment. This may affect the difference between the cooperative price and the futures price, as well as the predictability of this difference, which will increase the difficulty of use of commodity futures for the hedging of cooperative members' price risk.

4. Potential for reallocation of price risk among cooperative members

4.1. The model

Elaborating on the Collins (1997) model framework shows that cooperative member heterogeneity, in the usual factors which motivate hedging, yields potential gains from trade, by redistributing risk from members with a high cost of risk to members with a low cost of risk, as suggested more generally by Chavas (2011). One usual explanation for hedging is the reallocation of risk vertically in the supply chain. The idea suggested here is to utilize the potential gain from reallocation of risk horizontally in the supply chain, that is, reallocation among cooperative members with heterogeneous cost of risk.

As stated in Collins (1997, pp. 494-495), the "realistic objective of a single-period model is to maximize the expected effect of this period's operations on the firm's terminal equity [...] subject to the constraint that the chance that terminal equity is less than some disaster level (*d*) is less than *α*" which is the individual's acceptable probability of financial failure. Following Collins (1997), the model of terminal equity is:

$$\tilde{E}_1 = E_0 + [p_h H + \tilde{p}_c(1 - H)]Y - kY - iD - F \tag{1}$$

Where $\tilde{E}_1$ is the terminal equity, E_0 is the initial equity, p_h is the forward price of hedged output, H is the hedge ratio, $\tilde{p}_c$ is the stochastic cash price of the unhedged output, Y is output, k is variable costs, i is the interest rate paid on debt, D is debt and F is fixed costs. Given stochastic cash price of output, terminal equity is a stochastic function of not only realized cash price and the quantity hedged, but also the financial leverage of the firm.

Let $g\ (E_1)$ be the probability density function for terminal equity. The objective function is:

$$\begin{aligned} &\max \bar{E}_1 = \int_{-\infty}^{\infty} E_1 g(E_1)dE_1 \\ &\text{s.t.} \int_{-\infty}^{d} g(E_1)dE_1 \leq \alpha \end{aligned} \tag{2}$$

Expected terminal equity is:

$$\bar{E}_1 = E_0 + [p_h H + \bar{p}_c(1 - H)]Y - kY - iD - F \tag{3}$$

and

$$\frac{\partial \bar{E}_1}{\partial H} = p_h - \bar{p}_c \tag{4}$$

The relevant situations are where, $\bar{p}_c$, the expected spot cash price is above the forward price of hedged output $(\bar{p}_c > p_h)$ and there is a trade-off between expected terminal equity and a reduction in the risk of financial failure.

Following Collins (1997), suppose for simplicity that the price $\tilde{p}_c$ is uniformly distributed between the worst possible price (*a*) and the best possible price (*b*). The uniform density function is defined as:

$$f(p_c) = \frac{1}{b-a}, a \leq p_c \leq b; 0 \; otherwise \tag{5}$$

Further, following Collins (1997), given $f(p_c)$, the probability density function for terminal equity $g(E_1)$ is uniformly distributed with E_b representing the terminal equity under realization of (b) and E_a representing the terminal equity under realization of (a). The probability that a terminal equity level will be less than the disaster level is:

$$\int_{-\infty}^{d} g(E_1)dE_1 = \frac{d - E_a}{E_b - E_a}, \; E_a < d < E_b \tag{6}$$

Now suppose this model reflects the Danish situation for the marketing of milk and hogs. Because of near monopsony and prohibitive basis risk for futures markets, there are no effective hedging tools and $H = 0$. All cooperative members receive the same stochastic price $\tilde{p}_c$ for a given output, which reflects the residual claims in the cooperative.

If the goal of the marketing cooperative is to maximize the individual member's terminal equity subject to the constraint that the probability of terminal equity is less than some disaster level, which is less than the acceptable risk of financial failure, the ability to redistribute price risk among heterogeneous members will increase utility. The commonly stated goal of cooperatives is to maximize the commodity price received by their members. Whether the stated goal of maximum price is due to communicational convenience (as maximizing integrated profit may be a difficult concept to communicate) or otherwise, goals that maximize integrated profit and thus take the on-farm costs into account seem more relevant (Bogetoft and Olesen, 2000). Following Chavas (2011), the on-farm costs ought to include the cost of risk.

Suppose the marketing cooperative has three member segments, one with a low cost of risk, one with a medium cost of risk and one with a high cost of risk. Total quantity marketed through the cooperative is $Y_{coop} = Y_{low} + Y_{medium} + Y_{high}$ where the subscripts low, medium and high represent the three member segments.

The residual claims in the cooperative are:

$$[p_h H + \tilde{p}_c(1 - H)]Y_{coop} \tag{7}$$

where $H = 0$, by tradition. But suppose members were endowed with an equal and positive forward price and an equally positive and proportional forward priced quantity, $\bar{H}$. Equation (7) could be extended to:

$$\begin{aligned} &\left[p_h \bar{H}\frac{Y_{low}}{Y_{coop}} + \tilde{p}_c(1 - \bar{H})\frac{Y_{low}}{Y_{coop}}\right] + \left[p_h \bar{H}\frac{Y_{medium}}{Y_{coop}} + \tilde{p}_c(1 - \bar{H})\frac{Y_{medium}}{Y_{coop}}\right] \\ &\quad + \left[p_h \bar{H}\frac{Y_{high}}{Y_{coop}} + \tilde{p}_c(1 - \bar{H})\frac{Y_{high}}{Y_{coop}}\right] - [p_h \bar{H} + \tilde{p}_c(1 - \bar{H})]Y_{coop} \end{aligned} \tag{8}$$

Notice that the average price and the variation in average price are unchanged for all segments. However, marginal price ($\tilde{p}_c$) volatility (σ_c) is increased. Assume for convenience that the forward price is equal to the expected spot cash price, $p_h = \bar{p}_c$.

Now suppose cooperative members were allowed to exchange $\bar{H}Y_{coop}$ among each other at a market price z. Cooperative members with a high cost of risk would presumably be willing to pay zhY_{coop} for an increase in the forward contracted quantity by hY_{coop}. Similarly, cooperative members with a low cost of risk would presumably be willing to reduce the forward contracted quantity by hY_{coop} in return for pecuniary compensation zhY_{coop}.

The cooperative members with a medium cost of risk would be unwilling to pay z for a marginal increase in the forward contracted quantity, and unwilling to receive z for a marginal reduction in the forward contracted quantity. They would be unaffected at the average price volatility level, but would be affected by an increase in variation at the marginal price ($\tilde{p}_c$) level. Equation (8) could be extended to:

$$\begin{aligned}
&\left[p_h\bar{H}\frac{Y_{low}}{Y_{coop}} - p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{low}}{Y_{coop}} + \tilde{p}_c hY_{coop} + zhY_{coop}\right] \\
&+ \left[p_h\bar{H}\frac{Y_{medium}}{Y_{coop}} + \tilde{p}_c(1-\bar{H})\frac{Y_{medium}}{Y_{coop}}\right] \\
&+ \left[p_h\bar{H}\frac{Y_{high}}{Y_{coop}} + p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{high}}{Y_{coop}} - \tilde{p}_c hY_{coop} - zhY_{coop}\right] \\
&= [p_h\bar{H} + \tilde{p}_c(1-\bar{H})]Y_{coop}
\end{aligned} \tag{9}$$

The expected terminal equity for cooperative members with a low, medium and high cost of risk, respectively, is:

$$\begin{aligned}
\bar{E}_{low_1} = E_{low_0} + &\left[p_h\bar{H}\frac{Y_{low}}{Y_{coop}} - p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{low}}{Y_{coop}} + \tilde{p}_c hY_{coop} + zhY_{coop}\right] \\
&- kY_{low} - iD_{low} - F_{low}
\end{aligned} \tag{10a}$$

$$\begin{aligned}
\bar{E}_{medium_1} = E_{medium_0} + &\left[p_h\bar{H}\frac{Y_{medium}}{Y_{coop}} + \tilde{p}_c(1-\bar{H})\frac{Y_{medium}}{Y_{coop}}\right] - kY_{medium} \\
&- iD_{medium} - F_{medium}
\end{aligned} \tag{10b}$$

$$\begin{aligned}
\bar{E}_{high_1} = E_{high_0} + &\left[p_h\bar{H}\frac{Y_{high}}{Y_{coop}} + p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{high}}{Y_{coop}} - \tilde{p}_c hY_{coop} - zhY_{coop}\right] \\
&- kY_{high} - iD_{high} - F_{high}
\end{aligned} \tag{10c}$$

As pointed out above, the heterogeneity in factors which affect hedging behavior can take many forms (Pennings and Leuthold, 2000; Pennings and Garcia, 2004). Assume these factors are condensed in the cost of risk (Chavas, 2011) and assume, without loss of generality, that the cost of risk is inversely reflected in the level of acceptable probability of financial failure $\alpha_{low} > \alpha_{medium} > \alpha_{high}$ holding the disaster level equal for all members at the point of financial failure where $\tilde{E}_1$ is zero, $d_{low} = d_{medium} = d_{high} = 0$.

The objective function of the three segments could be stated as:

$$\max \bar{E}_{i\_1} = \int_{-\infty}^{\infty} E_{i\_1} g\left(E_{i\_1}\right) dE_{i\_1}$$
$$\text{s.t.} \int_{-\infty}^{d} g\left(E_{i\_1}\right) dE_{i\_1} \leq \alpha_i \text{ , where } i \in \{low, mediun, high\} \tag{11}$$

This means that members with a low cost of risk *ceteris paribus* will accept a higher probability of financial failure than members with a high cost of risk, against compensation of zhY_{coop}. Members with a high cost of risk will accept a lower expected terminal equity, $\bar{E}_{high\_1}$, in return for a lower probability of financial failure.

Assume that $g\ (E_{low\_1}) = g\ (E_{medium\_1}) = g\ (E_{high\_1})$ ex ante, before endowment of $\bar{H}$ and transfer of risk. The only thing separating the three segments is $\alpha_{low} > \alpha_{medium} > \alpha_{high}$.

As illustrated in Figure 1a, the condition for equation (11) is not satisfied for the high cost of risk segment, since the probability of financial failure is above α_{high}, the acceptable level of financial failure. Given the endowment of $\bar{H}$ it is possible to transfer risk among members in exchange for pecuniary compensation and obtain an ex post situation (Figure 1 b) in which risk is adjusted to the level where the probability of financial failure is equal to the acceptable level, for each segment. Expected terminal equity will shift from $\bar{E}_{low\_1} = \bar{E}_{medium\_1} = \bar{E}_{high\_1}$ in the ex ante situation to $\bar{E}_{low\_1} > \bar{E}_{medium\_1} > \bar{E}_{high\_1}$ in the ex post situation. $G(E_{i\_1})$ denotes the cumulative distribution function of terminal equity of segment *i*.

Assuming that $\frac{\partial Y}{\partial \sigma_c} = 0$, that $h > 0$ and zero transaction costs, a change in the traditional endowment of $\bar{H} = 0$ to $\bar{H} > 0$ will increase the aggregate utility without anyone being worse off. This constitutes a Pareto improvement. These assumptions, however, need further discussion.

Figure 1a. Cumulative distribution function of terminal equity, ex ante

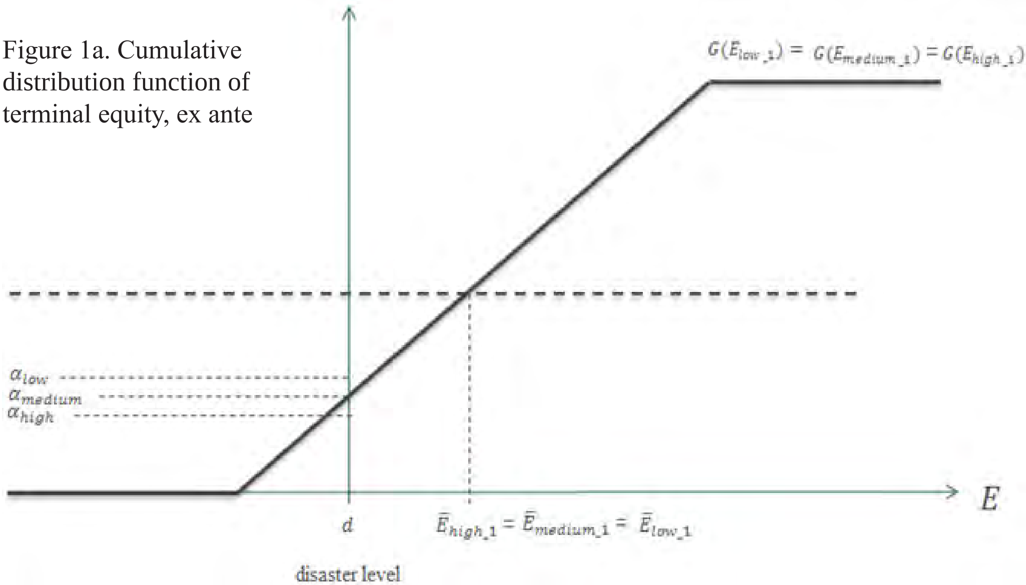
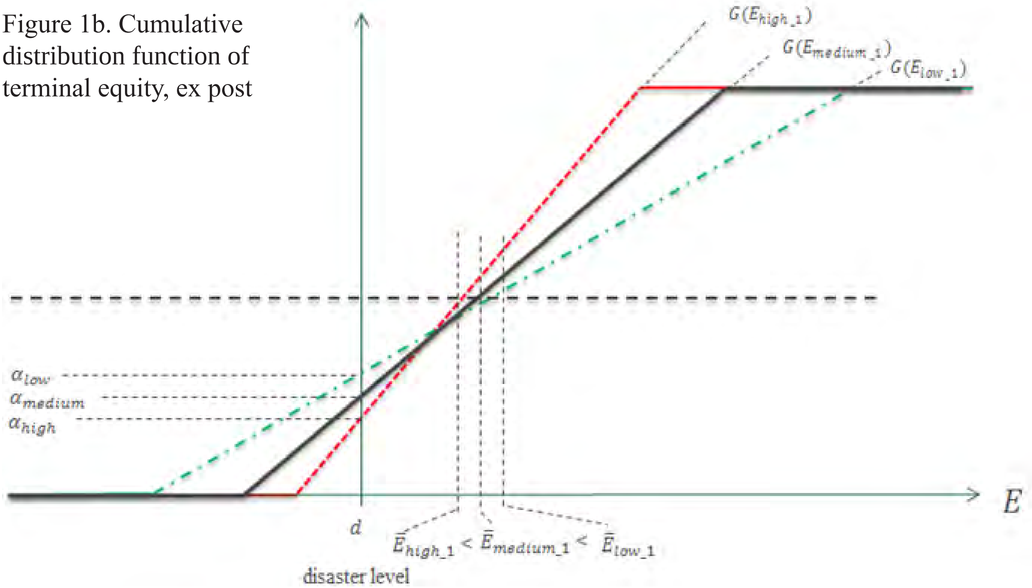


Figure 1b. Cumulative distribution function of terminal equity, ex post



4.2. Transaction costs

An actual endowment of $\bar{H} > 0$ and the subsequent exchange of forward contracting rights will incur some direct transaction costs. The cost structure of direct transaction costs will presumably have some fixed element related to setup costs, etc. If these are assumed to be negligible or covered more than fully by direct transaction fees paid by participating segments, there could still be room for Pareto improvement. In this case, non-participating members will no longer be unaffected but will receive part of the redistribution gains, that is the transaction fees paid by participating members less the part of direct transaction costs covered by the cooperative multiplied by $\frac{Y_{medium}}{Y_{coop}}$. Modern electronic market platforms have relatively low direct transaction costs, which is why assuming variable transaction costs, although a simplification of reality seems fair.

The model could be extended to cover variable transaction costs τ in the following way:

$$\begin{aligned}&\left[p_h\bar{H}\frac{Y_{low}}{Y_{coop}} - p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{low}}{Y_{coop}} + \tilde{p}_c hY_{coop} + zhY_{coop}\right.\\&\quad\left.-\frac{\tau}{2}hY_{coop}\right] + \left[p_h\bar{H}\frac{Y_{medium}}{Y_{coop}} + \tilde{p}_c(1-\bar{H})\frac{Y_{medium}}{Y_{coop}}\right]\\&\quad+\left[p_h\bar{H}\frac{Y_{high}}{Y_{coop}} + p_h hY_{coop} + \tilde{p}_c(1-\bar{H})\frac{Y_{high}}{Y_{coop}} - \tilde{p}_c hY_{coop} - zhY_{coop}\right.\\&\quad\left.-\frac{\tau}{2}hY_{coop}\right] = [p_h\bar{H} + \tilde{p}_c(1-\bar{H}) - th]Y_{coop}\end{aligned} \tag{12}$$

Expected terminal equity for cooperative members with a low, medium and high cost of risk, respectively, would be:

$$\bar{E}_{low_1} = E_{low_0} + \left[p_h \bar{H} \frac{Y_{low}}{Y_{coop}} - p_h h Y_{coop} + \tilde{p}_c (1-\bar{H}) \frac{Y_{low}}{Y_{coop}} + \tilde{p}_c h Y_{coop} + z h Y_{coop} - \frac{\tau}{2} h Y_{coop}\right] - kY_{low} - iD_{low} - F_{low} \tag{13a}$$

$$\bar{E}_{medium_1} = E_{medium_0} + \left[p_h \bar{H} \frac{Y_{medium}}{Y_{coop}} + \tilde{p}_c (1-\bar{H}) \frac{Y_{medium}}{Y_{coop}}\right] - kY_{medium} - iD_{medium} - F_{medium} \tag{13b}$$

$$\bar{E}_{high_1} = E_{high_0} + \left[p_h \bar{H} \frac{Y_{high}}{Y_{coop}} + p_h h Y_{coop} + \tilde{p}_c (1-\bar{H}) \frac{Y_{high}}{Y_{coop}} - \tilde{p}_c h Y_{coop} - z h Y_{coop} - \frac{\tau}{2} h Y_{coop}\right] - kY_{high} - iD_{high} - F_{high} \tag{13c}$$

If transaction costs are sufficiently low, there will still be potential for Pareto improvements by enabling the reallocation of price risk.

Assuming zero setup costs means zero costs if $h = 0$, this is of course a simplifying assumption. But given the turnover of the cooperatives in question, assuming the fixed setup costs of a price risk reallocation scheme to be negligible seems a fair simplifying assumption.

In reality, the cost structure of a risk reallocation mechanism is likely to involve relatively high fixed cost (setup costs) compared to negligible variable costs. The setup costs will, however, most likely be relatively low compared to the reallocation gain. Experiences from the introduction of a sugar beet contract exchange in Denmark in 2008 among farmers are good and the cost of running an exchange like this is negligible compared to the economic size of the cooperatives in question.

4.3. Quantity effect of increased volatility of marginal price

In the analysis above it was assumed that change in the volatility of price has no effect on output, $\frac{\partial Y}{\partial \sigma_c} = 0$. This assumption may be strong which is why the effect of relaxation is discussed as it may influence the model outcome. As Turvey (1989) points out, production and marketing issues are often treated independently, although they are inherently integrated parts of one decision problem.

As classical theory dictates, the short run production will be maintained as long as marginal revenue is greater than or equal to marginal cost, $\tilde{p}_c \geq k$. In the long run all costs will have to be covered. The question is how long is the long run? How flexible is the cost structure at the individual farm level and on the cooperative wide level.

The time horizon of the suggested endowment of forward contracts to cooperative members is a key variable. The contract horizon length is assumed to be positively related to the value of hedging. Very short contracts will approach a no contract situation, while longer contracts will improve cash flow predictability for members with an above average hedge ratio within the contract period. Members, having sold part of their forward contract endowment to other members, will have a below average hedge ratio. The price of accepting increased price volatility, for members with below average hedge ratio, will increase with the length of the time horizon of forward contracts. The optimal length of such contracts is beyond the scope of this paper, although a pragmatic suggestion for the time horizon of the forward contract could be that the hedged price p_h and quantity endowment $\bar{H}$ are specified in advance for the cooperative's fiscal year, stating p_h as the expected average price and the individual member endowment $\bar{H}_i$ to be based on the individual member's preceding year's delivery to the cooperative.

Suppose forward contract is specified as above, then the short run will become the cooperative's fiscal year. The volatility of the unhedged price $\tilde{p}_c$ will increase and will affect the production quantity in cases where $\tilde{p}_c < k$ with k representing the within year flexible costs. In general, the cost structure of modern Danish livestock production is relatively fixed and cases where $\tilde{p}_c < k$ will presumably be seldom. However, across the members of the cooperative, there will likely be a distribution of production technologies at work. Older production facilities that are near the end of their productive lifespan, may be shut down early in cases where $\tilde{p}_c$ is low. Similarly, these facilities may be kept in production for a while longer in cases where $\tilde{p}_c$ is high. This sort of dynamic will most likely have some effect on the total production Y_{coop} and $\frac{\partial Y}{\partial \sigma_c} \neq 0$ and thus have an impact $[p_h H + \tilde{p}_c(1 - H)]Y_{coop}$ and an accelerating impact on σ_c. The cooperative average price will be affected at some level and the above-mentioned impact on non-participating members will be understated. Pareto improvements will be less likely, as the possibility that non-participating members will not be automatically compensated will increase. There will, however, still be significant potential for improvement of the weaker Kaldor-Hicks efficiency measure as a function of the risk reallocation possibility (Gowdy, 2004).

5. Conclusions

The potential gain from the reallocation of risk among cooperative members will depend upon the distribution of cooperative member attitudes towards, and perceptions of, risk, their alternative risk mitigation possibilities and differences in financial structure and possibly the macroeconomic environment. Given sufficiently low transaction costs and sufficiently high heterogeneity of members, the potential gains would be positive. It is the author's belief that the potential is great in the current post GFC environment, although it is not static, as alternative ways of mitigating risk evolve dynamically and the potential will be conditioned on the present alternatives at any given time.

Until recently, institutions may have been in place that crowded out the need for price risk transfer away from some of the livestock producers in Denmark. These institutions may be changing drastically and the ability to transfer price risk may be becoming valuable. Traditionally, commodity futures are thought of as vehicles for the transfer of price risk vertically in the value chain. Here endowment and the transfer of forward contracts among cooperative members is suggested to extract the potential gains from the horizontal reallocation of risk.

Research questions like; what is the optimal endowment of $\overline{H}$? what is the optimal forward price p_h? and what is the potential gain from the reallocation of risk? are still open questions. However, it seems likely that advances in electronic market platforms and market design could reduce transaction costs to a sufficiently low level, where this type of reallocation could be a source of social gain. Price risk management tools could potentially alleviate some of the financial constraints that Danish agriculture is experiencing in the aftermath of the GFC.

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THE MARKET FOR ANIMAL-SOURCED FOODS IN TANZANIA: BUSINESS OPPORTUNITIES FOR SMALL-SCALE LIVESTOCK PRODUCERS?

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Abstract

Developing countries' consumption of high-value agricultural products, including animal-sourced foods, is anticipated to grow rapidly in the coming decades, fuelled by population growth, gains in real per capita income, and urbanization. Given that a large share of rural households in such countries keep some animals, a question arises as to whether the expanding market for animal protein represents a business opportunity for small-scale livestock producers. If consumers are anticipated to demand high-quality, highly-processed food products and do their shopping in supermarkets, there will be few opportunities for small-scale producers, who typically have insufficient human and financial capacity to meet that type of demand. Conversely, should consumers demand relatively low-quality and low-processed food products, then the growing market for animal-sourced foods will represent a major business opportunity for small-scale livestock producers. Available datasets and projections, however, while providing information on current and projected quantity of the different livestock products consumed at the commodity level, do not give details of preferred retail forms, outlets used and the desired safety and quality attributes. This paper presents the results of a rapid consumer survey undertaken by the Tanzanian Ministry of Livestock and Fisheries Development in collaboration with the World Bank-FAO-ILRI Livestock Data Innovation in Africa Project in Tanzania. The survey aimed at identifying preferred quality and safety attributes, retail forms and retail outlets for major livestock products and by type of consumers. Results of the survey, combined with nationally representative household datasets, allows describing both the quantitative and qualitative dimensions of the coming market for animal-sourced foods, which is anticipated to provide major business opportunities for small-scale livestock producers in the medium and short term.

Keywords: livestock, animal-sourced foods, consumption, small-scale producers, Tanzania

1. Introduction

The growing demand for animal-source foods in developing countries, dubbed the "Livestock Revolution" (Delgado *et al.*, 1999) anticipates unprecedented business opportunities for livestock producers. However, institutional and market imperfections make it difficult for many of those, and in particular for the disadvantaged, to tap into and benefit from the growing market for livestock products. The cost to society of such lost opportunities is justification for some form of public intervention, which helps smallholders access the market, improve their livelihoods and, in some cases, assist them in escaping poverty.

A major constraint on the design of effective investments to increase market access and utilization for smallholders is that, while information is available on trends in the overall consumption of animal products – such as those collected through household budget surveys – there are scant data and indicators to properly characterize livestock markets to identify and analyze opportunities. This is the case not only for quantities demanded but also for consumers' preferences for quality and safety attributes, retail forms of the product, and retail outlets. Yet, this information is a pre-condition for appreciation of opportunities for smallholders' effective benefits from the "Livestock Revolution".

This paper presents results of a rapid consumer assessment and retailer survey undertaken by the World Bank-FAO-ILRI Livestock Data Innovation in Africa project in Tanzania[1], which aimed at identifying the quality and safety attributes, retail forms and retail outlets preferred by consumers of animal foods. Results of the survey, combined with available national data which provide indications on the income and expenditure elasticities for livestock products by different typology of consumers, are used to better describe the emerging opportunities in the market for animal source-foods.

The next section briefly presents both the demand and supply side of the markets for livestock products in Tanzania, including projections for the consumption of livestock products in Tanzania and the 'representative' livestock producers. Section 3 presents the methodology developed to appreciate the preferred quality/safety attributes, retail forms and retail outlets by consumers in different income brackets and section 4 reports the results of a rapid assessment conducted in rural and urban areas of Tanzania. Section 5 presents conclusions.

2. Livestock products' consumption and production in Tanzania

Tanzania is a low income country with a population of about 46.2 million that is expected to grow by almost 3% per year 2011-2015. As in many sub-Saharan African countries, Tanzania has been recently enjoying a high level of economic growth, averaging 7% per year 2001-2011, which on a per capita basis is 4.1%. Similar rates of growth are anticipated for the coming years, which translate into a growing demand for animal-sourced foods (World Bank, 2011). However, per capita consumption is expected to to increase only for poultry and milk. In percentage terms, according to data from the FAO Global Perspectives Studies Unit, between 2005/07 and 2030 the total consumption of beef, sheep and goat meat, pork, poultry and milk is anticipated to increase by 87, 71, 88, 148 and 108% respectively (table 1); over the same period, the Tanzania population is anticipated to grow from about 40.1 million people to about 75 million, which partly explain the relatively minor increases in the per-capita consumption of animal-sourced foods.

Table 1. Tanzania current and projected consumption of selected livestock products

	Total consumption (000, MT)		Per capita consumption (kg / Lit)	
	2005/07	2030	2005/07	2030
Beef	262.5	490.7	6.5	6.5
Sheep and goat	40.9	70.0	1.0	0.9
Pork	13.5	25.4	0.3	0.3
Poultry	51.8	128.3	1.3	1.7
Milk	944.2	1962.9	23.5	26.0

Source: Courtesy of the FAO Global Perspectives Studies Unit

[1] http://www.africalivestockdata.org/afrlivestock/

A major question for policy makers is whether the expanding market for livestock products provide a major opportunity for livestock producers, thereby contributing to growth in the agricultural sector, and to poverty reduction in the (mostly poor) livestock producing areas. Indeed, according to Tanzania's 2008/09 National Panel Survey, about 61% of rural households keep some animals in Tanzania and that, at the same time, 60% of the rural poor are partly or wholly dependent on livestock for their livelihoods. The average herd size for a livestock keeping household is about 2.1 cattle equivalent (250 kg live weight), indicating that in most cases livestock producers are not specialized and, most likely, are unable to produce high quality surplus meat and dairy products[2]. Most of these producers, therefore, will be able to tap into the business opportunities provided by the growing market for animal foods only if consumers will demand relatively low-quality low-processed food products. However, information on the quality and safety attributes, retail forms and retail outlets preferred by consumers of animal foods is currently not available in any systemized of consistent form.

3. Methodology

A methodology was developed to capture information about different forms of Tanzanian consumers' preferred quality and safety attributes, retail forms, and retail outlets[3]. First, expert informants were interviewed to identify major types of retail outlets, including butcheries, roadside outlets, wet (open air) markets, small retail shops, supermarkets and milk vendors/ kiosks; as well as to identify five major quality/safety attributes for each product. For instance, for beef the following five attributes were identified: (1) Freshness; (2); Fat content; (3) Marbling; (4) Cleanliness of premises / presence of flies; (5) Packaging. An important criterion to select the attributes used here was that they had to be 'visible' to the enumerator, who could then attach a quality score to the product consumers were buying / retailers were selling. The simple (unweighted) sum of extant quality attributes was used as a scoring system as in Table 2. Weights could have been used to arrive at more nuanced quality/safety scores, but expert informants could not agree on specific criteria for such weights, particularly pointing out the differences likely to be expressed by different types of consumer.

Table 2. Quality / safety scale for livestock products

Number of positive attributes	Quality score
0-1	low
2	lower-medium
3	medium
4	upper-medium
5	good

As a second step, two sets of questionnaires were designed and administered to assess the level of wealth / income of consumers who were buying a given livestock product, in a given retail form, in a given retail outlet and of some observable quality. The first questionnaire was administered to retailers, and the second to consumers, of beef, chicken, eggs, goat meat, dairy products, and pork. Operators in a sample of retail outlets were asked questions regarding their perception of customers' level of income, trend in their sales of livestock products, and the main constraints on expansion of their businesses. Consumers were asked questions on the reasons why they purchased from a particular outlet, trends in their consumption of nominated retail products, willingness to spend more on specified livestock products; and two questions on means of trans-

2 The 2008/09 Tanzania National Panel Survey data are freely available for download at http://go.worldbank.org/U6O4OFC7U0

3 Jabbar et al. (2010) present an extensive discussion on quality and safety for livestock-related products

port, which were then used to cluster consumers into three income brackets. Enumerators also assessed quality both in consumers' observed purchase and on display in surveyed retail outlets.

A double stratified sampling method was used to arrive at the final sample. The first stratum consisted of urban and rural locations; the second of nominated categories of retail outlet in each location. Within each of the six categories of retail outlet, 3 outlets in urban areas and 3 outlets in rural areas were randomly selected, for a total of 36 outlets. Retailers were interviewed and, in each type of outlet, 4 consumers randomly selected –i.e. the first 4 that purchased some livestock products when the interviewer was in the retail show– were also interviewed, for a total of 144 consumers. Note that with this approach, while the number of consumers interviewed the different retail outlets is constant, there are differences in the size of the sub-samples of consumers purchasing the different types of livestock products, as table 2 below clearly shows.

Primary data collection (surveys) was undertaken during the month of October 2011, and took place in selected rural and urban locations. Urban outlets were visited in the districts of Ilala (Kariakoo) and Temeke (Tandika), while rural outlets were visited in Ilala district (Chanika).

Table 3. Sample sizes

Retail outlet	No. of retail outlets visited	No. of consumers interviewed	Livestock product	No. of consumers interviewed
Butcheries	6	24	Beef	36
Roadside outlets	6	24	Chicken	16
Wet markets	6	24	Eggs	20
Small retail shops	6	24	Pork	16
Supermarkets	6	24	Dairy	40
Milk kiosks / vendors	6	24	Goat	16
Total	36	144	Total	144

4. Results

4.1. Observed quality scores

Across all livestock products, results indicate that urban retailers offered generally higher quality and safety than did rural retailers except in the case of roadside outlets (Figure 1). Supermarkets obtained the highest score in the case of urban retailers, whereas butcheries ranked first among rural retailers. There is little difference among rural retailers in terms of quality and safety attributes' scores, with all of them obtaining medium quality scores. The difference is more pronounced among urban retailers where supermarkets scored 5 (good quality) and roadside outlets scored 2.5 on average (lower medium quality). Generally livestock products sold by urban retailers obtained higher quality and safety scores than did those sold by rural retailers, with the exception of pork[4].

4.2. Consumer type

Consumers were differentiated into three wealth / income brackets according to a straightforward proxy criterion: they were considered poor if they did not own any means of transport; belonging to the middle class if they owned a bicycle or a motorcycle; be among the rich if they

[4] Available from authors

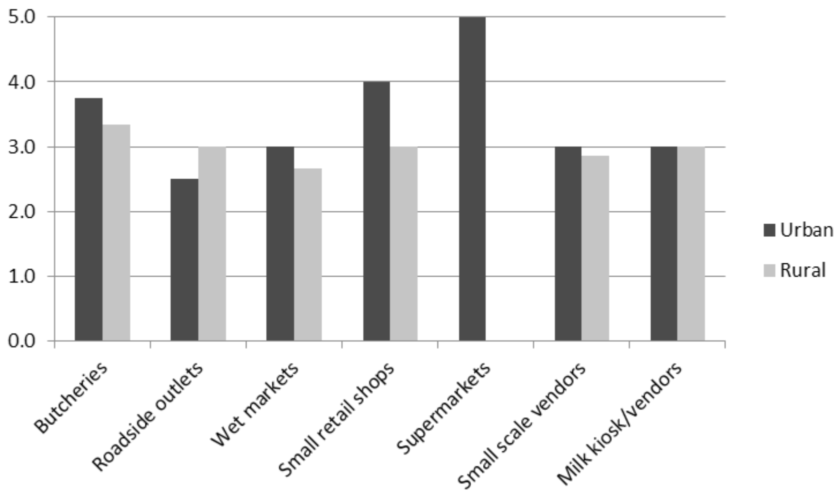

Figure 1. Average quality and safety scores in different retail outlets, urban and rural areas

owned a car. This criterion was considered as the most appropriate by expert informants but, admittedly, alternative criteria were not tested. The distribution of consumers by income status / ownership of means of transport is presented in table 3 below. Overall, 40% of consumers were assessed as poor; 30% as belonging to the middle class and 27% as better-off.

Table 4. Consumers by income status

Consumers	Less well off	Middle class	Better off	Total
Urban	26	25	21	72
Rural	32	22	18	72
Total	58	47	39	144

The result suggests that ownership of some means of transport, even if not the best predictor of level of wealth, seems to provide a reliable snapshot of the Tanzania population. For example, according to the 2008/09 National Panel Survey about 34% of the population live below the national poverty line. It is worth noting, however, that the concept of poverty used here is a relative one as, in most cases, the extreme poor or those living on less than 1 US$ PPP/day cannot afford to purchase livestock products. Data from the 2008/09 National Panel Survey indicate that about 38% of households do not consume livestock products in Tanzania, including 40% in rural areas and 29% in cities and towns.

4.3. Preferred retail outlets

The bar chart below (fig. 2) identifies the distribution of consumers by income bracket in the different retail outlets visited. Consumers of all income categories were found to purchase in all retail outlets. It appears, however, that less well-off consumers are more likely to purchase livestock products in roadside outlets, small retail shops than are middle-class and better-off consumers. These latter groups are more likely to purchase animal foods in supermarkets, butcheries and milk kiosks along the road. Wet, open air markets are the preferred retail outlets for all consumers.

There are two, complementary, explanations for these findings: first that relatively well-off consumers perceive as of low quality the animal products sold in roadside outlets and, when purchasing livestock products, tend to prefer specialized shops (butcheries) rather than small retail shops, which sell a variety of food products. A second explanation is that the median unit price

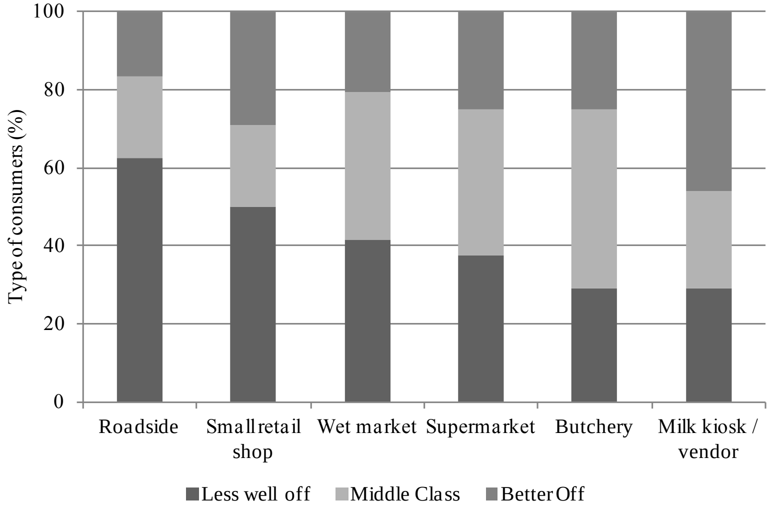

Figure 2. Types of consumers shopping in different retail outlets (%)

per livestock product was found to be significantly lower in roadside outlets and small retail shops (TzSh 2,250 and 2,400 respectively) than in butcheries and supermarkets (Tzsh 5,000 and 4,000 respectively). Prices of livestock products are very varied in open air markets, in which a range of livestock products are available; and relatively low for liquid milk, typically the cheapest source of animal protein for consumers.

4.4. Preferred retail forms

We present in the graphs below the preferred retail forms for beef, chicken and milk by consumers disaggregated into three income / wealth terciles. There were no differences in the preferred retail forms for pork and goat meats, which are always purchased in small pieces.

The results are consistent across the three livestock commodities, denoting some differentiation between the preferred retail forms for consumers in different wealth / income brackets. In the case of beef, poor consumers prefer purchasing either offals or mixed pieces, which are in general not consumed by the better-off. These are the cheapest beef products (offals in particular). Steak and sausages are apparently consumed by all types of consumer, but the sub-sample for these sub-products is very small and, therefore, we are not in a position to draw any clear conclusions in that regard.

As to chicken, again the less well-off are the only ones purchasing mixed pieces, such as legs and offal, whose price is low and averages about TzSh 1,300 per piece (*paja*). Live birds are bought by all consumers: these are largely appreciated as being more flavoursome than are industrially produced broilers. It should be noted that the price of live birds varies significantly, ranging from a minimum of TzSh 6,000 to a maximum of TzSh 12,000, which may indicate a segmented market.

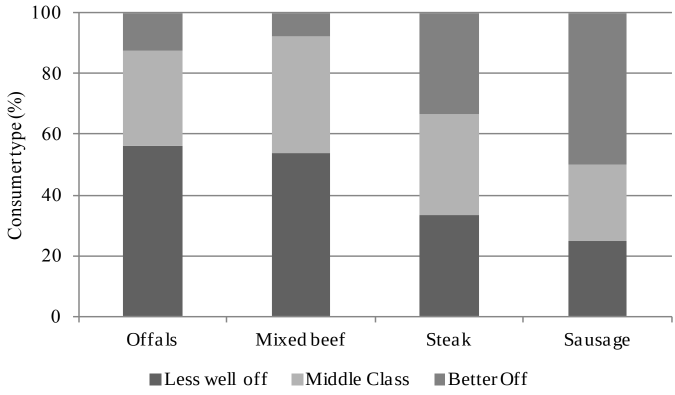

Figure 3. Beef: types of consumers (%) purchasing different beef sub-products

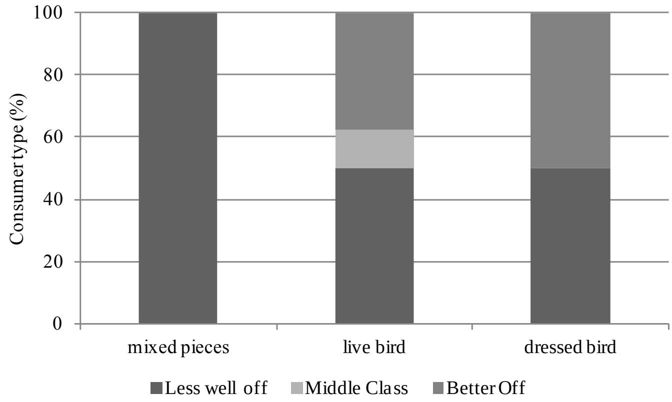

Figure 4. Poultry: types of consumers purchasing different chicken sub-products

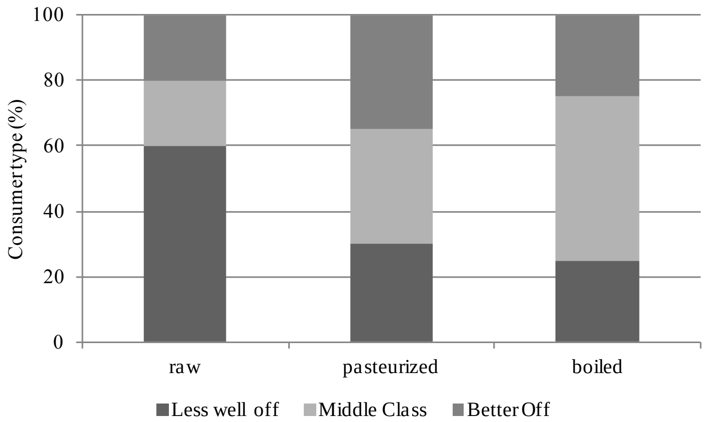

Figure 5. Milk: types of consumers purchasing different dairy sub-products

For milk, raw fresh milk – whose quality is often doubtful – is largely bought by poor and consumers; interestingly, however, its average and median price per litre were found to be not significantly different from those of pasteurized milk (both around TzSh 1,000 per litre), which could indicate that poor consumers purchase the products available in the retail outlet they visit, and/or that they assess as good the quality the raw milk they purchase. Boiled milked, which is bought at milk kiosks in urban areas, is mainly purchased by the middle class and the better-off, who can afford to pay only TzSh 500 on average for a glass of fresh milk.

4.5. Preferred quality scores by consumers

We present in Figure 6 the frequency distribution of quality scores by consumers in the three income brackets. Consistently with the observed quality/safety levels, which we found to be relatively high across all products and retail outlets, the average quality score is high for consumers of all levels of wealth. Paradoxically, better-off consumers seem to care less about quality and safety than consumers in other income brackets, but the differences are not significant. This result may also be due to the notably different preferences for retail outlets between income classes, exposing them to different levels of food safety and quality.

The most plausible reason for this findings is that, most likely, consumers in low income brackets purchase less frequently livestock products than middle-class and better-off consumers and, for them, any purchase of animal-sourced food purchase is considered as a major and occasional expense, contemplated with some consideration and caution. In other words, before buying any livestock product, poor consumers want to be sure that its overall quality is relatively good. Indeed, the perceived quality and safety is by far the most important determinants for consumers' stated reason for choice of retail outlet, followed by its being a 'known and trustworthy' premises.

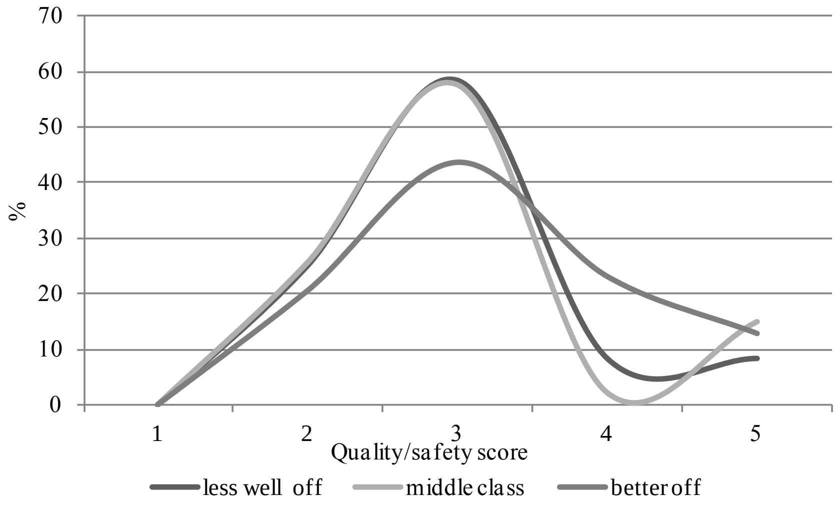

Figure 6. Frequency distribution of quality/safety score by type of consumer

5. Conclusions

This paper presents preliminary findings of a rapid appraisal conducted in Tanzania in 2011 for which the objective was to characterize the market for animal-sourced foods in terms of preferred safety and quality attributes, retail forms and retail outlets by different type of consumers. A methodology was developed to this end, which consisted of developing a matrix of visible quality and safety attributes. This was then used to attach an overall quality score to livestock products available in markets. Interviews administered to both consumers and retailers in randomly selected rural and urban retail outlets were then used to record buying behaviour and preferences over quality and retail outlet. Proxy measures of consumer income were employed.

Results indicate that consumers in different income / wealth brackets shop in different markets and prefer different retail products and that, on average, the overall quality of the livestock products sold / purchased is good, in both urban and rural areas and for consumers in all income brackets. These are important findings, for two reasons. First, they indicate that there are major opportunities for smallholder livestock producers to better utilize the market for animal-source foods in Tanzania, a country in which the majority of consumers is relatively poor or, as indicated by a nationally representative survey, still has yet to become ‘rich enough’ to purchase and consume livestock products (see Simon, 2000). Second, the results suggest that demand-driven interventions to increase the quality and safety of livestock products may be an effective way to enforce safety and quality standards, in the interests of avoiding the spread and dissemination of zoonoses and food-borne disease.

Results demonstrate that differentiation in products within a commodity group, and in qualities and retail outlets, is present in developing countries. The analysis presented here offers commercially valuable insight into the apparent opportunities for smallholder producers at those levels of product, quality and retail outlet specificity, and in association with the variety of incomes amongst consumers. To overcome barriers to smallholder livestock holders’ access to the market opportunities, public or external intervention may be warranted. This study focuses on the demonstration of a readily-applicable method of identifying the opportunities offered.

The results of the rapid assessment are preliminary, and based on a relatively small sample. They are however credible, and logical inference can be drawn from them. We plan to analyze further the data, including a comparison with results from a similar survey undertaken in Uganda, and build on this experience to refine the methodology and re-apply on larger samples of consumers.

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AN INTERNATIONAL COMPARISON OF THE MAIN MEAT SHEEP GENETIC SCHEMES

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Abstract

Meat sheep genetic schemes are compared in Australia, New Zealand, Ireland, United Kingdom and France thanks to interviews of professionals and regarding their organizations, genetic traits, innovations and economic. It appears that tools are rather similar but the cost of genetic control and indexation, selected animals and insemination are significantly diverse. Genomic is implemented all over the studied countries and should be a major change for the genetic improvement, with more efficiency in countries which have a reliable and centralized control system and database.

Keywords: lamb, mutton, selection, organizations, management

1. The world sheep meat context

The sheep meat is a minor sector representing only 3 % of the world meat consumption in 2012, according to IMS, USDA and GIRA data, but can be a significant activity in some regions like Oceania, East Asia, South America, Middle East and Western Europe for instance (Table 1).

However, the sheep and goat meat production increased rapidly during the last decades, especially in developing countries like China (Table 2).

Moreover, as shown in Table 3, sheep production has a low environmental impact compared to the other meat productions like beef, pig and poultry (FAO 2009b).

In the future, sheep meat demand is estimated to increase from 13 million tons in 2012 to 15 million tons in 2019 (Ashworth 2012).

In this fast changing context, our study aims at describing and comparing the organizations and orientations of the sheep genetic improvement systems for some meat sheep countries in the world.

Table 1. Sheep populations over the world (million heads in 2011)

	Asia	Africa	Europe	Oceania	America
Sheep population	464	255	127	104	93

Source: FAOSTAT 2012

Table 2. Compared evolutions of the different meat productions in the world (% variation 1987-2007)

Item	Pig	Poultry	Cattle	Sheep and goat
Developed countries	+6	+62	-14	-14
Developing countries	+186	+283	+92	+116
Of which China	+228	+3266	+1117	+600
TOTAL WORLD	+82	+142	+22	+63

Source: FAO 2009a

Aknowledgments: We want to thank the students of the "Ecole d'Ingénieurs de PURPAN" and its MSc EURAMA who helped us to inquire in the different countries: Pierre BOUTTES, Thibault CREPY, Jean Baptiste ENJELVIN, François FEUILLARD, Brenno FONSECA, Lisa HEESEN, Arnold van der LEIJ, Yongzhi YANG.

Table 3. Relative contributions of the animal species for the emissions of greenhouse gas along the food chain

	Cattle and buffaloes	Pigs	Poultry	Small Ruminants
LAND use and land use change	+++	+	+	NS
FEED production *	+	++	++	NS
Animal PRODUCTION **	++++	+	+	++
MANURE management	++	+++	NS	NS
PROCESSING and TRANSPORT	+	+	+++	NS

Note: from ++++ highest to + lowest. NS is non-significant
* excluding change in soil and plant carbon stock, ** including enteric methane, buildings and machinery+
Source: Adapted from Steinfeld et al.2006

2. Protocole of the study

We selected Australia, New Zealand, United Kingdom, Ireland and France because of their mature and diverse sheep genetic organizations even though their national flocks are not always important (see Table 4).

Table 4: Sheep population for the studied countries (million heads in 2011)

Country	AUS	NZ	UK	IRL	FR
Flock	73	31	32	5	8

Source: FAOSTAT 2013

For each treated country we will describe the genetic organizations, traits and index calculation, innovations and economics aspects. e did some bibliography researches and completed by a questionnaire to the main actors of the genetic schemes, filled by emails or phoning interviews. In cross-checking the information from the different sources within the same country, we gave ranges of data which have neither representative nor statistical value.

2.1. Australia

Australia is partially converting its wool flock to meat. Even though the merino breed is still dominant with 85% of the flock in 2002 (Barret 2003), the Meat and Livestock Australia (MLA) is forecasting the lamb production to rise from 0.4 million tons in 2011 to 0.5 in 2016 (MLA 2012).

Organizations in Australia

Meat and Livestock Australia (MLA), linked to the industry and the government, is driving Sheep Genetic Australia (SGA) which is genetically recording about 1000 sheep farms and 1 million sheep. This important database is coming from different independent associations like Lambplan (the most important in meat sector), Merinoselect or CSIRO Select for instance. Lambplan database has a significant part (15 to 20%) of the prolific Border Leicester breed in females like males, showing the importance for the meat sector in Australia. Within the main recorded meat breeds, the Poll Dorset represents 41%, the White Suffolk 36% and the Dorper 10%.

The system “Information Nucleus” aims at having a common progeny testing by Artificial Insemination, like presented in Figure 1.

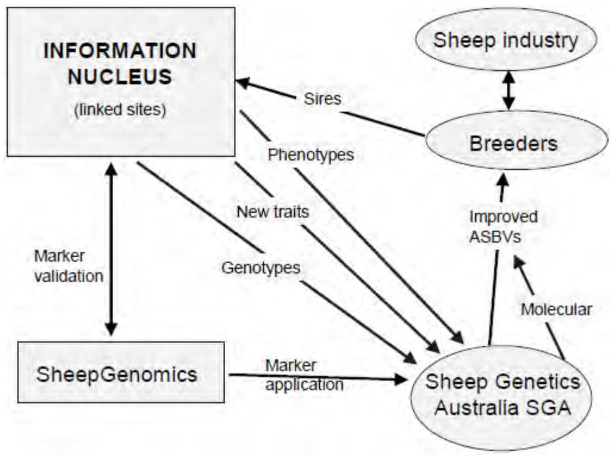

Figure 1. Industry linkage for the Information Nucleus
Source: Fogarty 2007

Traits and indexes in Australia

The estimated traits are: prolificacy, number of weaned lambs, birth weight, growth rate, fat and muscle width and depth (measured by echography), internal parasites resistance (measured by feces eggs counting), and scrotum circumference. Indexes are calculated either as a flock index for non-connected flocks, or as an Australian index for the connected flocks.

Innovations in Australia

Some new traits are studied: the lean meat yield, the intramuscular fat, the shear force, the lambing ease, the gestation length and the zinc and omega 3 composition of the meat. As for the genomic, a long term program has been set up in 2001 (95 million of Australian dollars) with about 100 rams and progeny which are genotyped with the 54K chip every year. Commercial developments are expected in 2013.

Economics in Australia

The Australian breeders are the main contributors to the implementation of the genetic tools cost, whereas the Government is the main contributor of the fundamental or applied research.

2.2. New Zealand

According to FAO statistics, the New Zealand sheep flock has been divided by two for the last 30 years, from 70 to 35 million heads. The sheep flock curve is clearly the opposite of the dairy herd one. New Zealand is much more meat oriented than his Australian neighbor. As shown in Figure 2, the dominant breed is the Romney with 46% of the national flock (Beef and Lamb NZ 2012).

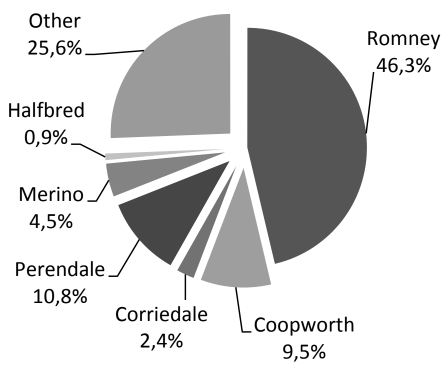

Figure 2. New Zealand sheep breeds
Source: Beef & lamb NZ Economic Service from sheep & beef farm survey 2009-10

Organizations in New Zealand

The inter-branch organization “Beef & Lamb New Zealand” is dealing with the sheep genetic databases through its unit Sheep Improvement Limited (SIL). The SIL is subcontracting the performance control to independent extension services and progeny tests about 200 rams a year on their wool production, mother ability and muscle yield. We can find numerous sheep breed associations, sometimes a few per breed. Some of them can participate to the performance control. For some genetic schemes, some breeders are setting some “breeding group” to exchange some rams or doing a common flock.

Traits and indexes in New Zealand

The main meat trait is the “Lean Meat Yield” mainly estimated by live echography (95% of the data), but as well by the CT-scan (precise but expensive) or the Via-scan (in the slaughter house). The breeders can also genotype their animal for the double muscle gene MyoMax (found in Texel) or the muscle development gene LoinMax (found in Poll Dorset). The reproduction traits are mainly the prolificacy and weaning rate. To face the helminthic resistance, the animal resistance can be estimated by either a phenotype counting protocol (WormFec, started in 1994) on the feces eggs, or by the blood antibody testing protocol. A similar protocol exists for the facial Eczema by dosing the enzyme. Most of the index are expressed in economic gains from the reference year 2005, meaning that the index are easily positive. Some synthetic index can be calculated for either the “Terminal Sire” index based on growth and meat yield, or the “Dual Purpose” index based on growth, reproduction and wool.

Innovations in New Zealand

An experimental program of genomic has been launched with OvitaLamb (Consortium of Agresearch and Beef & Lamb NZ) and Pfizer. The greenhouse gas emission, the ewe longevity and the lamb survival are also studied.

Economics in New Zealand

The genetic program is funded, approximately fifty percent each, by the taxes paid by the industry to Beef & Lamb NZ (0.4 NZ$/carcass) and by the breeders’ payment for the ewes controls. The progeny testing program like the genomic research are co-funded by the Government and the Beef & Lamb NZ.

2.3. United Kingdom

The British sheep flock has stopped his drop of nearly 30% from 2000 to 2009; however from 2009 the national flock is slightly increasing again to about 15 million ewes in 2012 and this rise is forecasted to continue in 2013 thanks to favorable prices and market conditions (EBLEX 2012). According to the level of the “three tiers system”, the main breeds are mainly the hardy breeds (Scottish Blackface, Welsh and Swaledale), the Longwool breeds (Bluefaced or Border Leicester) and the terminal breeds (Suffolk, Texel or Charollais).

Organizations in UK

The Meat and Livestock Commission (MLC), mainly funded by meat levies collected by state agencies like EBLEX (English Beef and Lamb Executive) for England, HCC (Hybu Cig Cymru, or meat promotion Wales) for Wales and QMS (Quality Meat Scotland) for Scotland, is driving the genetic schemes. The Signet Breeding Service, with the collaboration of EGENES (dependent from the Scottish Agricultural College), is in charge of the genetic database and indexation. The performance control is done by different organizations like flock books or private companies.

Traits and indexes in UK

The hardy breeds are mainly selecting the reproduction traits, maternal ability (live lambs 8 weeks after lambing), live weight (weight of the female at the first mating) and mortality. The Longwool breeds focus on prolificacy and the terminal breeds on lean carcass yield or fat content, estimated either by ultrasound echography at 21 weeks or by the more precise computed tomography scanning for 600 terminal sires. Indexes are transmitted as EBV (Estimated Breeding Value) or on a scale out of 100. Some synthetic indexes are made according to the system: Welsh Hill, Maternal, Hill, Longwool or Terminal. Some genetic schemes with progeny testing system have implemented a connexion via artificial insemination, called the “Sire Reference Scheme” (SRS).

Innovations in UK

A scoring of the maternal ability for lambing is developed for the Scottish Blackface. It includes the lambing assistance, the lamb vigor at 5 minutes (difficult to measure) and the suckling assistance. A test for the detection of the double muscle gene is on the market. And the nematode resistance starts to be integrated into some schemes. A footrot resistance gene has been identified by genomic method, but no scheme based on genomic seems to be implemented up to now.

2.4. Ireland

According to the CSO Census of Agriculture in 2010, the total number of sheep in Ireland fell from 6.8 million in 2000 to just 4.7 million in 2010, a decrease of one third. This was mainly due to the low profitable and high labor demanding sheep farms compared to other productions like beef or dairy cattle for instance. As for the United Kingdom, the sheep number is slightly increasing from 2010 to reach 5.1 million head in 2012 (DAFF 2012). The sheep breeds are diverse, but clearly dominated by the Suffolk (Table 5).

Table 5. Sheep breeds in Ireland, in % of heads

Breed	Suffolk	Scottish Blackface	Cheviot	Texel	Charollais	Belclare	Leicester
%	51	14	12	10	4	3	2

NB: excepted for Cheviot and Scottish Blackface, the breed numbers are including crossed animals
Source: Jones 2008

Organizations in Ireland

The “Sheep Ireland” organization is in charge of the meat sheep genetic schemes, it is linked to the Irish Cattle Breeding Federation (ICBF). Sheep Ireland is running three programs:

- Lambplus: recording and indexing the sheep of about 250 farms.
- Maternal Lamb Producers (MALP): progeny testing about 22 sheep farms to assess the rams on their maternal qualities.
- Central Progeny Test (CPT): progeny testing about 4 sheep farms to assess about 32 rams (Suffolk, Rouge de l’Ouest, Charollais, Belclare, Texel and Vendeen) on their meat qualities.

Traits and indexes in Ireland

The Lamplus program is recording: the lambing ease (scored from 1 to 4), the growth (weights at lambing, 40 days and weaning), the mortality and the fat and muscle depth by scanning. The programs of MALP and CPT are adding as well the diarrheas level, the laming rate and the ewe live weight. The CPT is implementing the feces eggs counting. Three types of indexes are calculated: the production index (lamb growth, muscle and fat development), the maternal index (weaned lamb weight, muscle and fat development and lamb survival) and the lambing index (lambing ease and lamb survival). In 2009, those three indexes have been combined in a new synthetic one called the "Overall Sheep Value" that you can find on the "Eurostar Indexes". The genetic indexes are also expressed as an economic value.

Innovations in Ireland

A "health index" including footrot and a gastro-intestinal parasite resistance indexes are under studies.

Economics in Ireland

Sheep Ireland is 100% funded by the DAFF. However, even though the funding has been negotiated for 4 years, it is decreasing from the starting year in 2009.

2.5. France

The French sheep flock is about 4 million meat ewes and 1.5 million dairy ewes. Concerning meat breeds, two main types are used: specialized meat breeds (Ile de France, Mouton Charollais, Texel, etc.) and hardy breeds (Lacaune viande, Blanche du Massif Central, Merinos d'Arles, etc.).

Organizations in France

By gathering all the stakeholders of breeding programs, FGE (France Genetique Elevage) coordinates and manages the national collective system of the ruminant genetic improvement. L'Institut de l'élevage (the French Livestock Institute) is responsible, in collaboration with INRA (French National Institute for Agricultural Research) for the technical coordination, methods and protocols, database management system and breeding values computing. Only licensed operators

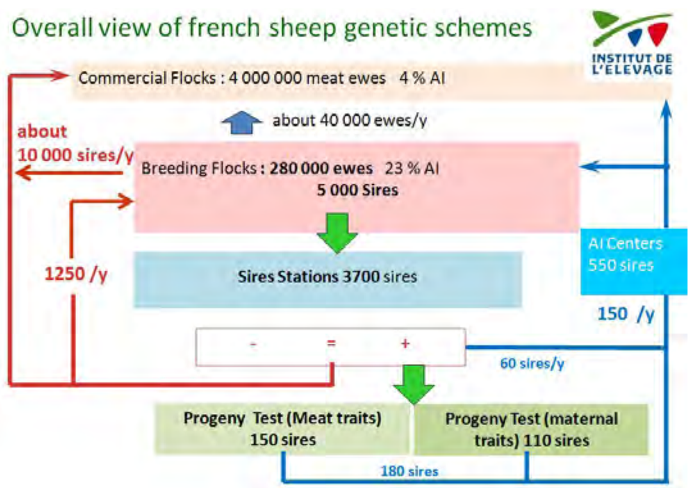

Figure 3. Organization of the French meat sheep genetic schemes
Source: document from Institut de l'Elevage

are authorized to do the recording. This collective system ensures the reliability of data used for genetic evaluations (France Génétique Elevage 2011).

Breeding programs (including breeding objective definition) and flock-book are managed by certified Selection Agencies. Only one can be certified by breed. Almost 280,000 ewes (1200 breeders), are registered for official data recording, and about 3700 rams are evaluated each year in collective ram station.

Traits and indexes in France

Breeders select for both maternal and meat traits. Thus, whatever the breed, improving maternal ability is always important because lamb productivity is a major factor explaining return of meat sheep farms. Equally, improving meat abilities remains a significant objective for specialized meat breeds and some hardy breeds which are commonly used as purebred (Table 6). Data recording is performed on farm and on ram station. For several breeds, a progeny testing is also performed. In station, according to the specific objectives of each breed, a synthesis index is calculated, combining the four basic breeding values related to meat ability. Various breeding values are performed thanks to a progeny testing on meat and/or maternal abilities and, most often, a synthesis index is calculated.

Table 6. Main selected traits for the French meat sheep genetic schemes lambs nt system, ion, methods

TRAITS	Data recording	Comment
Prolificacy	F	litter size
Mothering value	F	indirectly measured by 30-day-weight of lambs
Post-weaning growth	F	based on Average Daily Gain in grams between 30 and 70 days
Growth	S	based on Average Daily Gain in grams during control (8 weeks)
Weight at fixed age	S	between 140 to 170 days old, depending of breed
fat at fixed weight	S	based on fat thickness measured by ultrasound
muscle development at fixed weight	S	based on body score and muscle thickness measured par ultrasound
growth and carcass quality	PT	weight, yield, fatness, etc. measured on at least 30 carcasses
Scrapie resistance	F&S	All rams carrying the sensitive allele VRQ have been culled. All young males used in breeding schemes are resistant to Scrapie (ARR / ARR)

F = Farm, S = ram Station, PT = Progeny Testing
Source: (Tiphine 2011)

Innovations in France

Taking recent results on new traits into account requires a long process before integrating them in the breeding goals. Currently 3 new traits should be quickly available for breeders:

- Parasitism resistance (based on individual worm egg counts after artificial infestation)
- Reactivity to humans (based on challenging tests involving human contact)
- Feed efficiency (based on individual consumption measured by concentrate feeder).

Concerning the genomic implementation, the Scrapie program has constituted a large-scale implementation of gene assisted selection for all sheep breeds. Others types of mutation carried by genes, such as myostatin gene or ovulation genes have already been managed in breeding programs. Nevertheless many questions remain, like their inclusion in genetic evaluation. Others studies are still in progress: for instance, potential benefits of genomic selection and use of molecular markers for parentage assignment.

Economics in France

The genetic program is funded by the Government, by taxes paid by farmers and by the breeders' payment for the recording.

3. Compared genetic costs

The costs of the genetic registration, performance controls, selected animals and insemination are quite diverse according to the studied countries as shown in Table 7.

Table 7. Compared genetic costs for sheep farmers

Cost in euros (*)		AUS	NZ	UK	IRL	FR
Indexation	Registration & Performance control	265/year 80/intervention 1.3/ewe 8/ram	1-2/ registered ewe 1.3-2.6/ controlled ewe	10.5/ controlled ewe	100/ year	4/registred and controlled ewe (from 0,8 to 10)
	Echography		2-3.3/ram 65/for CT scan		3/ animal	15,24/animal (2 measures-only in collective station)
Indexed rams	For breeders	4000-20000	320-3200	1300-4000		300-1000
	For commercial flocks	800-2000	250-600	400-1200/ terminal sire 700/ hardy ram	350-500	200-500
Reproduction	AI (laparoscopy)	28	12-24	140 + 8-19	8-18	10 vaginal AI + semen
	Semen dose	16-50	12-20	25-65	15-70	

(*) currency conversion rates: 1 AUS$ = 0.8 € and 1 NZ$ = 0.65 €
Source: from inquiries done from Autumn 2011 to Spring 2012

4. A benchmark attempt for the meat sheep genetic schemes

4.1. Organization

Some countries have very centralized genetic organization like France who has only one database and indexation unit for all the controlled breeds in the country, some other countries are very decentralized with sometime several indexation schemes within the same breeds like United

Kingdom for instance. The centralized systems can draw profit of an optimum connecting net for progeny testing, especially if the artificial insemination is widely spread. Consequently, the index accuracy is usually high and the genomic tools more efficiently developed in those systems.

4.2. Traits and breeds systems

The traits are quite the same concerning the growth rate and carcass quality (muscle and fat). However, some countries have early integrated some disease or parasite resistance traits like New Zealand or Australia. Some interesting attempts to build an ideal "dual purpose" (meat and maternal) breed can be noticed like the Romane in France (ex-INRA401 from Romanov and Berrichon du Cher), where the breed composition were highly controlled, or the Cambridge in UK or the Belclare in Ireland, where the breed composition were more diverse.

The more complex "combined breeds", like it is practiced in New Zealand, can also be considered as an attempt to build an ideal "dual purpose" breed. The British "three tiers systems", largely used in UK and Ireland is combining hardy, prolific and meat breeds all along the chain but in keeping the pure breeds nucleus and using the hybrid vigor improvement at each generation.

4.3. Economics

The funding of the sheep genetic schemes is coming from either Government, or industry or farmers. The origins are rather divers around the world, but in a nutshell we can make a difference between some countries which have a significant part of the sheep genetic investment coming from the Government (France, or Ireland for the recent years), industry (United Kingdom) or farmers (Australia).

However, even if it is difficult to precisely estimate, it would be interesting to share an analysis of the investments profitability like the SRUC (ex-SAC in Scotland) tried to do in their document "Breeding gains for the sheep sector" (KNOWLEDGESCOTLAND 2011). We can also differentiate two ways to orient the communication on the index.

- "Economic index": like in Ireland, where the indexes are regularly communicated with their conversion in potential economic return.
- "Technical index": like in France where the indexes most often remain in physical units with a clear communication on accuracy levels.

4.4. Innovation

Genomic is obviously the new technology that would deeply transform the sheep breeding schemes. It is progressively integrated in the dairy cow and dairy sheep breeding schemes and some beef cattle ones but still has to be strengthened for a good implementation in the meat sheep schemes.

The double muscle gene has started its commercial development in such countries like New Zealand. The Scrapie resistance gene has already been widespread all over the French schemes. Many studies have been recently done on prolificacy genes identification and the availability of genotyping could significantly transform the actual slow intra-breed selection of this trait, which has a low heritability and a long cycle when we use progeny testing.

But no large program of sheep genetic schemes has been based on genomic yet. This should be affordable in regions or countries that have high average index accuracies thanks to a full and reliable identification and traceability system, a centralized and precise genealogy registration and a powerful connected indexation system.

5. Conclusions

The world context for meat market like the environment pressure could represent an optimistic opportunity to the sheep meat sector. However, the meat sheep genetic schemes are rather diverse among countries and have no significant world governance institutions, international genetic scheme or professional exchanges. This sector could draw an interesting profit from a higher exchange in a benchmarking and win-win attitude.

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DETERMINING FACTORS OF STRUCTURAL CHANGE IN AGRICULTURE IN SWITZERLAND

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Abstract

This study used data from the Swiss Farm Structure Survey (FSS) and the non-randomly sampled Farm Accountancy Data Network (FADN) data to analyse the forces driving farm exits between 2001 and 2011. These data were used in binary logistic regression models to estimate exit probabilities, controlling for structural and economic factors.

Using both FSS and FADN data, the logit results show that the probability of farm exit is directly related to farm size, operator age, number of manpower units per hectare, and farming system. The probability of farm exit decreases for younger but increases for older operators. Organic farming, family size and farming full-time are also found to have a significant negative influence on exit. By contrast, work intensity and sex of the farm operator positively influence farm exits.

The logit model based on the FADN dataset revealed that economic variables are less useful than structural/social characteristics for explaining the variance of the exit probability. At first glance, this finding is surprising, since it reveals that the economic situation is not of primary importance in the decision to exit or remain in the sector.

Keywords: farm exit, structural change, logistic regression, FADN, farm survey

1. Introduction

Switzerland has seen significant structural change in the agricultural sector over the past few decades. In addition to influencing job opportunities in farming, agricultural structure has consequences for other areas such as the extent of agricultural-policy measures, the necessary number of training positions, spatial-planning measures, and the landscape in general. That is why it is of interest to identify the determining factors of structural change.

This paper focuses on the farms exiting from the agricultural sector and the factors influencing this exit. To allow for a more precise forecasting of structural change in agriculture, the present study draws on both the agricultural structure censuses and the accountancy test-farm network / Farm Accountancy Data Network over a period of around ten years.

The paper is organized as follows. Chapter 2 outlines the methods and the underlying data used. Chapter 3 contains the results and discussion, while Chapter 4 consists of the conclusions.

2. Method and data

2.1. Main data sources

In order to identify and better understand the factors influencing structural change, two data sources are used. The first, Swiss agricultural census data, also known as the Farm Structure Survey (FSS), includes all farms in Switzerland, and has enabled the assessment and monitoring of Swiss agriculture (BfS/ FSO, 2012). FSS provides detailed insight into the structural, technical and socio-demographic situation of almost all Swiss farms on an annual basis but contains no economic data. The current investigation is based on the FSS's from 2001 and 2011 covering a total population of 68,784 farms in the year 2001. In addition to the FSS data, frequent use is made of economic information from the non-randomly sampled FADN data. The FADN is administered by Agroscope Reckenholz-Tänikon Research Station ART. This comprehensive database includes detailed information on cost accounting from about 3,300 farms per year.

2.2. The Logit Model

In this article, a logistic regression model is used to estimate the probability of farm exit (P) during the period 2001-2011:

$$\log\left(\frac{P_j(\mathbf{Y}=\mathbf{1})}{\mathbf{1}-P_j(\mathbf{Y}=\mathbf{1})}\right)=\alpha+\sum_{i=1}^{k}\beta_i\cdot x_{ji}+\varepsilon_j$$

where log is the natural logarithm, X_j is a vector of k exogenous variables (e.g. various farm and operator characteristics) for the j-th farm, β is a vector of k coefficients to be estimated, and ε_j is a stochastic error term.

2.3. Structural variables influencing farm exit

Decisive factors for structural change have already been the subject of numerous investigations (Baur, 1999; Hofer, 2002; Mann, 2003; Foltz, 2004; Snell, 2005; Hoppe and Korb, 2006; Juvancic, 2006; Key and Roberts, 2006; Weiss, 2006; Kirner and Gazzarin, 2007; Rossier, 2007; Meier et al., 2009; Pushkarskaya and Vedenov, 2009; Petrick and Zier, 2011). According to this literature, factors affecting structural change can be grouped under human capital, farm structure, structural environment and socio-economic categories.

We use the following set of structural variables in the logistic regression based on the FSS data (Table 1).

The dependent variable (FARMEXIT) represents whether a farm exits the agricultural sector during the period 2001 to 2011. The variable FARMEXIT is equal to 1 when a farm (i) leaves the sector between 2001 and 2011, or (ii) is merged with another farm, or (iii) is handed over to a new farm operator who is not a member of the family.

2.4. Economic variables influencing farm exit

Most analyses of the likelihood of exit of specific farm operators only take structural and social factors such as land size and education and age of the operator into account, while ignoring the economic perspective. Given that farm structure surveys do not provide economic data at individual-farm level, this is hardly surprising. By matching FADN farms with FSS farms[1], we can model the influence of key economic variables on exit probability. This section sets out the economic variables that may affect the decision to exit (cf. Table 2). The factors are grouped into different categories, and are based on a literature review (e.g. Goetz and Depertin, 2001; Foltz, 2004; Key and Roberts, 2006; Hoppe and Korb, 2006; Breustedt and Glauben, 2007; Petrick and Zier, 2011), as well as on available information.

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1 A sample of 2484 farms could be matched.

Table 1. Definition of variables used in the 'exit of/entry to agricultural sector' model

Variables	Description
Dependent variable	
FARMEXIT	1-The producer exits the agricultural sector (or his ID number changes); 0-The farm exists from the beginning to end of the time period
Explanatory variables	
AGE	Age of the producer (years; recorded in 2001)
AGE^2	Square of the age of the producer ($years^2$)
FEMALE	1-The producer is female; 0-Male
FAMILY	Number of workers belonging to the family (No.)
EMPLOYEES	Number of employees (No.; Part-time employees weighted according to hours worked)
LAND	Utilised agricultural area (ha)
$LAND^2$	Square of the utilised agricultural area (ha^2)
GROWTH	1-The average change in utilised agricultural area per year between 2001 and 2011 (or the last year the farm exists) is greater than 1 ha; 0-Otherwise
LULAND	Livestock units per area (LU/ha)
$LULAND^2$	Square of livestock units per area ($(LU/ha)^2$)
FULLTIME	1-Full-time farm; 0-Part-time
ORGANIC	1-Organic farm; 0-Non-organic
WORKLAND	Number of workers (family members and employees) per area (No./ha; Part-time workers weighted according to hours worked)
CALCWORK	Calculated working hours required for crops and livestock, per number of workers (hours/No.; Part-time workers weighted according to hours worked)
CALCBENEFIT	Standardised contribution margin per area (CHF 1000 /ha; standard values per crop and livestock unit)
TYPCROP	1-Crop farm (Open arable land accounts for over 70% of total area); 0-Otherwise
TYPSPECIAL	1-'Special crops' farm (Special crops account for over 10% of total area); 0-Otherwise
TYPMILK	1-Dairy farm (Cattle account for over 75% of livestock, of which at least 25% are dairy cows); 0-Otherwise
TYPSUCKLER	1-'Suckler cow' farm (Cattle account for over 75% of livestock, of which at least 25% are suckler cows); 0-Otherwise
TYPCATTLE	1-'Other cattle' farm (Cattle account for over 75% of livestock, of which fewer than 25% are cows); 0-Otherwise
TYPHORSE	1-Horse, sheep or goat farm (Horses, sheep and goats account for over 50% of livestock); 0-Otherwise
TYPPIGPOUL	1-Pig or poultry farm (Pigs and poultry account for over 50% of livestock); 0-Otherwise
TYPCOMBCROP	1-Combined farm with crops (Other farms, open arable land account for over 40% of total area); 0-Otherwise

Table 2. Economic variables influencing farm exit

Category	Variable[a]	
Income	Work income per family member	*WIFAM*
	Agricultural income per hectare	*AIHEC*
	Ratio of off-farm income to total income	*OFFARM*
Investment	Investment-to-assets ratio* * Buildings, machinery, installations, land (without livestock)	*INVASS*
Financial situation of farm	Degree of external financing = debt/equity ratio	*DER*
	Ratio of (fixed) assets * to labour * Buildings, machinery, installations, land (without livestock)	*ASSLU*
	Ratio of direct payments to total gross performance* * Total gross performance does not include subsidies	*SUBSGP*
	Direct payments per hectare	*SUBS*
Partial-productivity indicators	Labour productivity = $\frac{\textit{gross performance}}{\textit{annual labour unit}}$	*LAPR*
	Capital productivity = $\frac{\textit{gross performance}}{\textit{capital}}$	*CAPPR*
	Land productivity = $\frac{\textit{gross performance}}{\textit{UAA}}$	*LANDPR*

[a] The *italicised* abbreviations in CAPS are used throughout the text

3. Results and discussion

The first section of the results is based on the FSS data. Due to the high number of farms, the analysis can be performed separately for different farm types. The subsequent two sections focus on FADN farms.

3.1. FSS model

The results of the logit model based on the FSS database (hereinafter referred to as the FSS model) are listed in Table 3. It shows that the probability of farm exits is significantly influenced by characteristics such as farm size, previous farm growth, and farm type (as an index of on-farm diversification). Farm size and size squared are both highly significant. Coefficient signs of the two farm-size variables indicate a nonlinear relation between farm size and exit.

In addition to these farm characteristics, Table 3 suggests a number of personal characteristics of the farm owner which have a significant influence on farm succession and exit. In particular, a significant life-cycle pattern can be observed in the farmer's succession and exit behaviour. The effect of age (AGE) on the probability of farm exit is negative for young farmers, becoming positive when AGE exceeds 38 years. The size of the farming family (FAMILY) is another important factor for determining farm succession and exits. A highly significant and negative impact on farm succession and exits is reported in Table 3 for farms with larger families. These results are not surprising, since family members provide both an incentive and the necessary labour resources for continuing the family-farm business. All else being equal, farms operated by a woman (FEMALE = 1) are 1.22 times more likely to exit than farms operated by a man. The parameter estimate for FULLTIME is highly significant. If the farm manager spends over 1500 working hours on the farm (FULLTIME = 1), the probability of exit decreases by almost 50% relative to a part-time farm.

Table 3. Parameter estimates for the FSS model for the whole population and two selected farm types

	All farms			Crop farms			Dairy farms		
	coefficient		odds ratio	coefficient		odds ratio	coefficient		odds ratio
Constant	2.509	***		2.507	***		4.137	***	
FEMALE	0.198	***	1.220	0.126		1.134	0.271	*	1.311
EMPLOYEES	0.032	***	1.032	-0.195		0.823	0.081		1.085
FULLTIME	-0.611	***	0.543	-0.463	***	0.629	-0.511	***	0.600
ORGANIC	-0.357	***	0.700	0.179		1.196	-0.518	***	0.596
WORKLAND	0.261	***	1.299	1.884		6.578	1.107	**	3.026
CALCWORK	-0.112	***	0.894	-0.158	**	0.854	-0.042		0.959
CALCBENEFIT	-0.008	*	0.992	-0.069		0.934	-0.015		0.985
FAMILY	-0.364	***	0.695	-0.387	***	0.679	-0.474	***	0.623
AGE	-0.134	***	0.875	-0.130	***	0.878	-0.192	***	0.826
AGE^2	0.002	***	1.002	0.002	***	1.002	0.003	***	1.003
LAND	-0.037	***	0.963	-0.028	***	0.972	-0.048	***	0.953
$LAND^2$	0.020	***	1.021	0.014	*	1.014	0.037	***	1.038
LULAND	-0.277	***	0.758	-1.670	***	0.188	-0.707	***	0.493
$LULAND^2$	0.041	***	1.042	1.865	***	6.455	0.124	***	1.132
GROWTH	-0.553	***	0.575	-0.700	***	0.497	-0.644	***	0.525
TYPCROP	0.129	**	1.138						
TYPSPECIAL	0.084		1.087						
TYPMILK	0.156	***	1.168						
TYPSUCKLER	-0.160	**	0.852						
TYPCATTLE	0.183	***	1.200						
TYPHORSE	0.234	***	1.264						
TYPPIGPOUL	-0.060		0.941						
TYPCOMBCROP	-0.087		0.917						
R^2	0.296			0.342			0.235		

* indicates statistical significance at the 10%-level; ** indicates statistical significance at the 5%-level; *** indicates statistical significance at the 1%-level

Diversification of farm has been controlled for by using several farming-type dummy variables (TYPCROP, TYPMILK, etc.). Table 3 also reports a significant impact of on-farm specialisation on farm exits and succession (for the sake of brevity results for only two farm types are shown).

3.2. Logit regression of economic FADN data

Logistic regression analysis was used to investigate the effect of the economic variables on the probability of exiting the agricultural sector. The basic model was set up with the dependent variable FARMEXIT (1 = exit, 0 otherwise) and the 11 explanatory variables given in Table 2. The logarithm (base 10) was used for the three partial-productivity indicators (LAPR, CAPPR, LANDPR) and ASSLU. Because of negative values in WIFAM and AIHEC, these two variables may not be log-transformed.

The full model was simplified by the stepwise omission of non-significant variables (based on the Akaike Information Criterion (AIC) criterion) in order to obtain a meaningful and interpretable model (hereinafter referred to as the reduced model). Interactions of variables have not been taken into account. The results of the logit regression of the reduced model are summarised in Table 4. The Pseudo-R2 is 0.083. The Pseudo-R2 of the full model (with all 11 economic variables from Table 2) is only slightly higher (R2 = 0.089). Thus, economic variables only explain approximately 9% of the total variance of the dependent variable FARMEXIT. Nevertheless, the model gives a valuable insight into factors which are significant triggers of exit probabilities.

Table 4. Results of logistic regression (explanatory variables restricted to economic factors)

Variable	Coefficient		Standard error	Odds ratio	Marginal effect[2]
Constant	16.5	***	3.20		
WIFAM[1]	$-5.0 \cdot 10^{-5}$	**	$2.93 \cdot 10^{-6}$	1.000	$-2.2 \cdot 10^{-7}$
log(SUBS)	-0.818	**	0.36	0.441	-0.037
log(ASSLU)	-2.673	***	0.47	0.069	-0.120
log(CAPPR	-1.672	***	0.65	0.188	-0.075

[1] Note that the variable WIFAM is not log-transformed; 2 Marginal effects are evaluated at the median of the data

From Table 4 we conclude that an increase in agricultural income per family member leads to a lower probability of exit. Given that a (too-) low income from agricultural activity is likely to be a relevant factor in farm exit, this is to be expected. The model reveals that an increase in WIFAM by CHF 100,000 decreases the probability of exit by 0.022 (2.2%). The farm operator is obviously more motivated to stay in the sector when he or she receives higher subsidies per hectare (SUBS). Thus, the model suggests that subsidies negatively impact on farm exit: a tenfold increase in SUBS decreases the exit probability by 3.7% (0.037). The existing literature has failed to reach a consensus on the impact of subsidies on agricultural employment. In line with our findings, some authors report the expected, negative impact (e.g. Foltz, 2004; Key and Roberts, 2006), whilst others find the impact to be positive (Hoppe and Korb, 2006; Petrick and Zier, 2011). Berlinschi et al. (2011) argue that subsidies have a positive effect on the educational level of farmers' children, and thus on long-term labour supply. The factor ASSLU (assets per labour unit) also impacts negatively on exits from the agricultural sector. This result was predictable, since capital-intensive farms generally invest more in their machinery and buildings, thus indicating their commitment to continuing to farm. The marginal effect of -0.075 (Table 4) states that a tenfold increase in the capital productivity CAPPR decreases the exit probability by 0.075 (7.5%).

3.3. Logit regression of combined structural and economic data

In this section, we estimate the logistic regression using both structural/social and economic variables from the FADN database. The full model therefore includes the merged variable set from Tables 1 and 2 (ignoring the dummies for the farm types). Of particular interest here is whether economic or structural/social data explain more of the variance of the goal variable FARMEXIT.

Again, as in the previous section, the reduced model arising from the stepwise omission of non-significant variables (based on the AIC criterion) is presented, rather than the detailed results for the full model. The final model explains 25% of the total variance (i.e. Pseudo-R2 = 0.25) of

Table 5. Results of logistic regression including both structural/social and economic variables

Variable	Coefficient		Standard Error	Odds Ratio	Marginal Effect
Constant	11.80	***	4.06		
AGE	-0.305	***	0.089	0.737	-0.0132
AGE^2	0.00371	***	0.00094	1.004	0.000161
LAND	-0.0633	***	0.017	0.939	-0.00274
WORKLAND	8.87	***	2.81	7095	0.385
log(LANDPR)	-3.32	***	0.89	0.036	-0.144
log(ASSLU)	-1.82	***	0.49	0.1625	-0.0788
AIHEC[1]	$-1.52 \cdot 10^{-4}$	***	$5.76 \cdot 10^{-5}$	0.998	$-6.59 \cdot 10^{-6}$

[1] Note that the variable AIHEC is not log-transformed

the dependent variable FARMEXIT. The full model is only marginally better, with a Pseudo-R2 of 0.262. From this and from the results in Section 3.2, we learn that the structural/social variables are significantly more important for modelling exit probability. Table 5 provides detailed information on the (logistic) output of the reduced model.

An analysis of the statistical model's output given in Table 5 reveals that the reduced model includes seven significant explanatory variables, three of which are economic parameters. A comparison of Tables 4 and 5 shows that the significant economic variables differ for the model including structural/economic variables and the model considering economic data only.

The effect of age on the exit probability FARMEXIT is displayed in Figure 1. The figure shows that exit probability decreases with operator age at a young age, but increases once a threshold age is reached. Farm exits due to financial stress are more likely among farmers in the early phase of their careers. Furthermore, it is probably easier for younger farmers to find a job outside the business (Breustedt and Glauben, 2007). The negative relationship reported for farm operators at younger ages may be explicable in terms of learning effects and the acquisition of experience (Jovanovic, 1982). Furthermore, switching from farming to a non-farm job becomes a less viable option as the individual ages, since specific human-capital investments are involved. The exit probability of older farmers strongly increases because of lower opportunity costs associated with off-farm work; operators thus end up staying in agriculture until natural retirement. This finding is in line with the bulk of the available literature (e.g. Gale, 2003; Weiss, 2006; Breustedt and Glauben, 2007). Note that age can be also seen as a proxy for various distinct effects such as management skills, life horizon, physical depreciation, and others.

Farm size (LAND) is highly significant in the model. The negative coefficient (see Table 5) indicates that as farm size increases, farms are less likely to exit. Hence, farm size contributes positively to farm survival, since larger farms are more likely to provide the farming family with a reasonable, sustainable income. This is borne out by many other studies (e.g. Baur; 1999; Hofer, 2002; Breustedt and Glauben, 2007). Farm size thus has a negative marginal effect (-0.00274) on FARMEXIT, the probability of which tends to decrease by approximately 0.03 when farm size increases by ten hectares.

The variable WORKLAND impacts positively on exit probability: Given farms of equal size, those with more employees tend to leave the sector more frequently. Labour efficiency and thus a streamlining of the business would therefore appear to be crucial for the survival of farms. The logit model gives us a 0.0385 increase in FARMEXIT for each 0.1 increase in the number of employees per hectare.

As expected, we find that increased land productivity (LANDPR) decreases the probability of exit from the farming sector. Increasing LANDPR by a factor of ten leads to a decrease of 0.144 in exit probability. The fixed-assets-to-labour ratio (ASSLU) impacts negatively on farm exit. Farms with capital-intensive machinery and well-equipped animal housing thus encourage farm operators to remain in the sector. The economic status of the farm is directly reflected in the agricultural income per hectare (AIHEC). Clearly, increasing AIHEC values reduce the desire of the farm manager to leave the sector.

It is of some interest that the two variables which include subsidy payments (SUBSGP, SUBS) do not enter the final model. This in line with Barkley (1990), who suggests that government payments do not necessarily influence changes in agricultural employment, and thus the number of farms, whilst e.g. Breustedt and Glauben (2007) find that higher subsidies lower the exit probability in European countries.

4. Summary and conclusions

This study used data from the Swiss Farm Structure Survey (FSS) and the non-randomly sampled FADN data to analyse the forces driving farm exits between 2001 and 2011. These data were used in binary logistic regression models to estimate exit probabilities, controlling for structural and economic factors.

Using both FSS and FADN data, the logit results show that the probability of farm exit is directly related to farm size, operator age, number of manpower units per hectare, and farming system. The probability of farm exit decreases for younger but increases for older operators. Organic farming, family size and farming full-time are also found to have a significant negative influence on exit. By contrast, work intensity and sex of the farm operator positively influence farm exits.

The results of the model with the full set of variables (i.e. including economic variables) show that farm exit (FARMEXIT) is significantly influenced by the three economic variables LANDPR, ASSLU, and AIHEC. Despite this, the two variables which include subsidy payments (SUBS, SUBSGP) and investments (INVASS), do not enter the reduced model after the omission of variables. These findings are in line with those of Barkley (1990), who discovered no relevant impact of government payments on agricultural employment, and those of Breustedt and Glauben (2007) who concluded that the subsidy variable is not significant in the regression. A possible reason for the non-significant investment variable INVASS may be the typical investment/divestment pattern according to the three stages of life-cycle models (Pushkarskaya and Vedenov, 2009) which are well represented by the (highly significant) variable AGE.

The logit model based on the FADN dataset revealed that economic variables are less useful than structural/social characteristics for explaining the variance of the exit probability FARMEXIT. At first glance, this finding is surprising, since it reveals that the economic situation is not of primary importance in the decision to exit or remain in the sector.

It is evident from the literature that numerous other factors such as good management practices, knowledge and early adoption of new technology, and love of farming impact on farm success (e.g. Hassan and Nhemachena, 2008). In addition, information on the farm manager's decision-making process and the organisation of the farm may affect farm profitability. As this information is not available in either the FSS or the FADN data, however, an additional survey would be required to allow a more-detailed analysis to be performed.

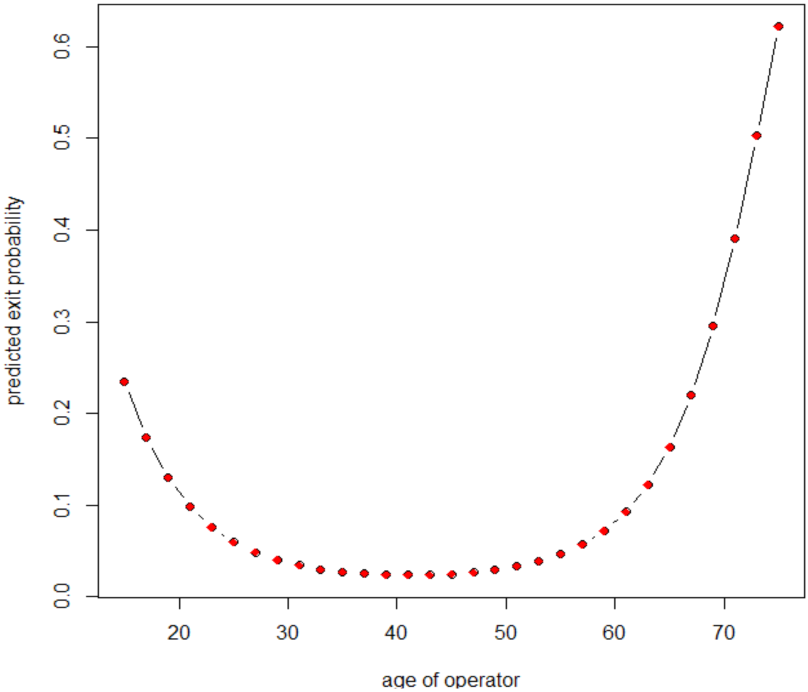

Figure 1. Effect plot for exit probability based on the reduced logit model as described in Section 3.3. Variables other than *age* and *age2* are kept constant to their median value

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PRETESTING THE SUITABILITY OF THE INCOME VALUATION FRAMEWORK ON THE AGRICULTURAL COMPANIES WITHIN THE VISEGRAD GROUP

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Abstract

The income valuation framework presents high-powered, complex and math-intensive process. Therefore, any pretesting of valuation objects can be beneficial and time saving for the individual professional appraisers. Since the income valuation approach is based on the estimation of the income value of the company on an ongoing-concern basis, if this basic assumption is not met by the valuation object, the other approaches need to be employed. This paper closely examines theoretical and practical aspects for the initial stage for the application of the income valuation methods on the agricultural companies within the member countries of the Visegrad Group. Firstly, the applicability of the income valuation methods is verified via the indicator of value spread, as a difference between the return on equity and costs of equity and secondly, the conclusions are drawn properly. This paper finds that only a part of the sample is suitable for income valuation, for the majority of companies the income valuation methods are rather non-applicable, due the fact that some of the basic requirements are not met. Based on empirical tests, it was shown that there is a slightly positive dependence between the value spread indicator and the country of origin of the agricultural company.

Keywords: agricultural company, company value, income valuation framework, net income, value spread

1. Introduction

A large body of literature has explored the magnitude of company value measurement by various methods based on the net present value principle (Plenborg, 2002; Koller, et al. 2010). This principle applied on company valuation is derived from the dividend discount model (DDM) originally employed for valuation of stocks (Brealey, Myers and Marcus, 2007). Despite the broad use of the income valuation methods, their applicability is closely connected with the company's future perspective, so called going concern principle. If it cannot be assumed that a company remains viable and active in the future, the income valuation methods are not applicable. The overall process of company valuation via the income valuation methods is rather complex and extensive including various math-intensive sub-calculations. Therefore, it might be useful to know in advance, whether the income method requirements are met and thus the method is applicable for a specific company (valuation object). Among the essential requirements ranks the going concern principle, which is met if the positive cash flow can be expected in the long term (Mařík, 2007). There is a possibility to examine the fulfilment of some of the other requirements via so called value spread (Mařík, 2007). The value spread is a difference between return on equity and costs of equity and can be considered as a pre-test of applicability of the income valuation framework. The positive

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difference indicates the retaining the ongoing-concern basis, whereas any negative difference may imply difficulties in preservation of such a basis. Moreover, as presented below in the equation, value spread serves as a basis for the model of residual income (RI) valuation. The empirical usefulness of residual income valuation model (RIVM) was discovered for example by Stubelj, et al. (2009); however, Plenborg (2002) expresses the RI approach in terms of financial ratios, as:

$$P_0 = BV_0 + \sum_{t=1}^{\infty} \frac{(ROE_t - r_e)BV_{t-1}}{(1+r_e)^t} \tag{1}$$

where *P* is the firm value, *BV* the book value of equity, *ROE* the return on equity, and r_e the cost of capital (equity holder). The RI is defined as the difference between ROE and r_e, known as the value spread, multiplied by the BV (Plenborg, 2002).

Any value creation in a company is closely related to the relation between the rates of return obtained (ROE) and expected (r_e) (Mařík, 2007). The individual profitability ratios do not measure the company's success nor reflect the factor of risk. However, if ROE indicator is compared to the opportunity costs, it provides the information about company's overall financial situation. The success or failure can be easily identified based on the size of the value spread: by how many per cent is the ROE higher/lower than the r_e. The multiplication of the value spread by the shareholders' equity means the economic profit generated within the year by the company (Neumaierová, 2005). The limitation of this spread lies in its historical nature, since it measures only historical parameters and cannot provide predictive perspective (Vavřina and Růžičková, 2012).

In this paper, the value spread criterion is challenged by the traditional economic tool: the book profit/loss, i.e. earnings after taxation (EAT). Even though this indicator is still widely used and connotes the overall economic prosperity of a company, its validity as economic performance indicator is rather arguable. EAT of a company are calculated as the sum of all relevant expenses deducted from sales realized. EAT can be considered as net income (NI) or profit/loss for the year. To have a positive EAT does not necessarily mean showing adequate economic performance, not only due to the different accounting policies, but also due to the extraordinary company activities (Mařík, 2007). In addition, EAT provides only the information from the current year, and uses nominal or historical prices. Companies can be also compared based on EAT, however, there is a need for respective system of peer group clustering according to for example range of economic activities, provided services and total economic size of all participants via employing relevant indicator (Vavřina and Růžičková, 2012).

This paper contains an investigation of whether or not agricultural companies from member countries of the Visegrad group (V4) create value using the value spread between company's ROE and r_e. Moreover, the value spread is challenged by the net income of these companies. Finally, the independence of the value spread and country of origin of the agricultural company is verified via the Chi-square test of independence, and if the dependence is detected, the Cramer's V coefficient is employed. The following hypothesis is tested:

- H_0: Creating/destroying value according to the value spread method does not depend on the country of origin of the agricultural company within the observed sample.

The objective of this paper is to examine the dependence between the value spread and the country of origin of the agricultural company. The findings of this paper may be used for the process of company valuation, namely for pre-selection of suitable valuation objects, since the income valuation methods cannot be applied widely. Moreover, the findings may also discover potential differences between the sample companies from the V4 countries. These differences can stem from the different political systems, public subsidy policies, climatic zones, or geographical location.

2. Methodology

The sample used in this paper consists of all active agricultural companies from the V4 member countries listed in the database Amadeus of Bureau van Dijk (Amadeus) in 2010. The Amadeus database contains and provides comprehensive financial information on millions European companies. The data are standardized and collected by national agencies. For the purposes of this paper, the year 2010 was selected together with 4004 companies from the agricultural sector (CZ NACE 01), see table 1.

Table 1. Number of companies according to the country of origin

Country ISO Code	Number of companies
CZ	1616
PL	1064
SK	714
HU	610
Total	4004

Source: own elaboration based on the data provided by the Amadeus

For each company the following variables were calculated as follows:

- The net income is the profit (loss) for the year. If this indicator is lower than zero, it means company is making a loss, i.e. negative net income. If the indicator is above zero, it means company is generating a profit.
- Return on equity *(ROE)* is calculated as profit (loss) for period divided by shareholders equity, expressed as a percentage (i.e. multiplied by 100).
- Costs of equity *(r_e)* are estimated via build up model INFA as heuristic model which determines r_e as a sum of risk-free rate and individually estimated risk premiums specific for particular company (Neumaierová, 2005).

$$r_e = r_f + RP \tag{2}$$

where r_f is the risk-free rate and RP stands for additional risk associated with company size, business risk, financial stability and financial structure.

- The value spread is calculated as a difference between ROE and r_e. If the return is higher than costs, the new value is created, if the return is lower, the value is destroyed.

$$value\ spread = ROE - r_e \tag{3}$$

To verify the value creation of agricultural companies in the each V4 member country, the value spread was calculated for each individual company within the sample.

Chi-square test of independence was used to investigate the independence between value spread and country of origin of the agricultural company. Both variables are categorical: value is created/is not and country of origin of the agricultural company is CZ (Czech Republic), PL (Poland), SK (Slovakia), or HU (Hungary). The general Chi-square test of independence framework by Hendl (2009) is used, as provided below:

$$\chi^2 = \sum \frac{(observed\ frequency\ - expected\ frequency)^2}{expected\ frequency} \tag{4}$$

where χ^2 is Pearson's test statistic which can be compared to critical value with degrees of freedom on the given significance level. The degrees of freedom (*df*) can be calculated as a number of categories in the table *r* x *s: (r-1)*(s-1)*. In the case the hypothesis is rejected, the dependence is further examined by other coefficients, for example by the Cramer's V coefficient.

$$V = \sqrt{\frac{\chi^2}{n(m-1)}} \quad (5)$$

in which *V* is the Cramer's V coefficient, *n* the total number of cases and *m* is the lower number of total rows or columns. The Cramer's V coefficient is within the scope of (0, 1); when the coefficient is equal to zero, there is no dependence; if the coefficient is 1, there is a strong relation between selected variables.

The independence test is given on the 5% level of significance (P value = 0.05).

3. Results and discussion

The contingency table (tab. 2) is provided for the value spread and net income overview according to the country of origin of the agricultural company. Each row presents the absolute and also relative frequency of companies firstly with positive and secondly with negative value spread according to the company's net income, for example, in the CZ there are only 483 companies from the CZ sample, i.e. 29.9% of CZ companies, having positive value spread and generating profit at the same time and 804 companies, i.e. 49.8%, still generating profit but having negative value spread. At the end of each row, the total absolute or relative frequency is shown, for example, in the CZ, there are 1287 companies generating profit, i.e. 79.6% of the CZ sample. Analogously, each column provides absolute and relative frequency of companies according to the profit/loss and at the end, the total absolute or relative frequency for value spread is shown, for example, in the CZ, there are 483 companies creating positive value spread, i.e. 29.9%, but more than 70% is destroying the value, expressed as negative value spread (in 1133 cases).

Table 2. Selected variables and their frequencies in the contingency table

Country ISO Code	Net income	Absolute frequency			Relative frequency		
		value spread		total	value spread		total
		positive	negative		positive	negative	
CZ	profit	483	804	1287	29.9%	49.8%	79.6%
	loss	0	329	329	0.0%	20.4%	20.4%
	total	483	1133	1616	29.9%	70.1%	100.0%
PL	profit	532	424	956	50.0%	39.8%	89.8%
	loss	0	108	108	0.0%	10.2%	10.2%
	total	532	532	1064	50.0%	50.0%	100.0%
SK	profit	139	339	478	19.5%	47.5%	66.9%
	loss	0	236	236	0.0%	33.1%	33.1%
	total	139	575	714	19.5%	80.5%	100.0%
HU	profit	104	384	488	17.0%	63.0%	80.0%
	loss	0	122	122	0.0%	20.0%	20.0%
	total	104	506	610	17.0%	83.0%	100.0%
Total	profit	1258	1951	3209	31.4%	48.7%	80.1%
	loss	0	795	795	0.0%	19.9%	19.9%
	total	1258	2746	4004	31.4%	68.6%	100.0%

Source: own elaboration based on the data provided by the Amadeus

According to the findings it appears, that while profit-generating companies are prevailing in all countries, companies creating value for its owners having ROE (obtained returns) higher then r_e (expected returns) are rather rare, only 29.9% in the CZ, 19.5% in SK, and 17% in HU. The most optimistic situation appears to be in PL, where the ratio is 50% of companies creating value. According to the indicator of net income, the situation appears quite optimistic in all V4 countries: there are almost 80% profit generating companies in CZ, almost 90% in PL, almost 67% in SK and 80% of companies in HU. Therefore, there must be companies generating profits but not creating value for the owners via the value spread approach. These facts lead to conclusion that the EAT perspective provides misleading information about economic performance of agricultural enterprises: profit-generating companies do not cover their r_e by ROE (in almost 50% of cases in CZ, almost 40% in PL, almost 48% in SK and 63% in HU). This disproportion can be a result of low ROE, or high r_e. Unfortunately, both these aspects are typical for agricultural companies (Kopta and Maršík, 2009).

For the verification of the relation between the two variables (value spread and country of origin of individual agricultural company) the Chi-square test of independence was employed (tab. 3).

According to the results of the Chi-square independence test (and critical value approach) the hypothesis about the independence: *„Creating/destroying value according to the value spread method does not depend on the country of origin of the agricultural company within the observed sample“* can be rejected on the given significance level.

Table 3. Results of Chi-square test of independence and Cramer's V coefficient

Pearson Chi-Square (test statistic)	278.028
Degrees of freedom (d*f*)	3
Critical value	7.8153
Significance level of the test (alpha)	5 % (0.05)
Cramer's V coefficient	0.264

Source: own work

Therefore, it can be said that creating/destroying value (value spread approach) depends on the country of origin of the agricultural company: CZ, PL, SK, HU, within the observed sample. Since creating value according to the value spread is not independent on the country of origin of the agricultural company, symmetric measure (Cramer's V coefficient) was employed. Based on the coefficient, the dependence between the variables is slightly positive.

The slightly positive dependence may confirm the facts that in agriculture, the return ratios are often negative (Kopta and Maršík, 2009) and therefore cannot cover the r_e which are estimated via INFA method, which uses risk premium for each individual company. Moreover, Střeleček et al., (2007) have identified important characteristics of Czech agricultural companies: increasing dependence of public subsidies on net incomes, which can be considered as above-average compared to EU-15. Moreover, Vavřina et al. (2012) provide the evidence, that this is the case of all V4 agricultural companies. Based on this fact, it can be inferred that EAT can be partly shielded by these subsidies. Vavřina et al. (2012) also show that there is an increasing tendency of public subsidy financing in the period 2004 – 2011. As far as the public subsidies are concerned, any reduction or elimination of this kind of financing would inevitably lead to slump of the entrepreneurial income in Slovakia (Božík, 2011). Agricultural companies in PL appear as most economic efficient, on the other hand, they are beneficiaries of side-subsidies which may result in better economic performance (tab. 3). Therefore, it cannot be directly assumed that Polish agricultural companies are more competitive in comparison with the other V4 member countries (Vavřina et al., 2012).

There are also other differences stemming from the production deviation: crop vs. animal production. In SK, for example, local agricultural companies have to face decreasing trend of the arable land area, in favour of setting the land aside of the producing (Božík, 2011). Moreover, Božík (2011) states that there is a slump of animal production tending to the end of animal production in SK at all.

Considering selected variables, net income and the value spread, as proper indicators of applicability of income valuation methods, these indicators have highlighted 30% of companies in CZ, 50% of companies in PL, 20% of companies in SK, and 17% of companies in HU with positive value spread and net income, therefore suitable for the application of income valuation methods. The indicator of net income has individually highlighted 80% in CZ, 90% in PL, 67% in SK and 80% of companies in HU. Based on these facts, the indicator of the value spread is more precise and provides more accurate information about the applicability of income valuation method. Companies with positive value spread (30% in CZ, 50% in PL, 20% in SK and 17% in HU) can be suitable sample for smooth application of the income valuation method. Cumulatively, only 31.4% of all V4 agricultural companies are suitable for the income valuation methods application (tab. 3). Based on this fact, there are 68.6% of companies to be valued by alternative approaches. Besides the income valuation approach, these companies can be objects for asset approach valuation framework (Koller et al., 2010). The aforementioned facts may lead to conclusion, that a majority of V4 agricultural companies do not cover their r_e by ROE and therefore cannot be objects for income valuation methods.

4. Conclusions

Overall, the picture that emerges from agricultural companies in the V4 is consistent with the findings of Banaszak (2007), Kopta and Maršík (2009), Mickiewicz (2012) or Vavřina et al. (2012). There is a confirmation, that the value spread is positive only in 31.4% of cases: only 31.4% of the sample report higher ROE than r_e. This fact may be caused by agricultural specifics, namely by considerable fluctuations in cash flow, low return ratios or high indebtedness which is reflected in the higher r_e, as outlined by Střeleček et al., (2007), Banaszak (2007) or Vavřina et al. (2012). Whereas the net income indicates greater percentage of companies to be profitable, according to the value spread, the majority reports negative difference between obtained and expected returns. Additionally, there is evidence that companies creating value do have to generate a profit, but companies destroying their value do not have to report a loss.

For the verification of the relation between the two criteria (value spread and country of origin of the individual agricultural company) the Chi-square test of independence was employed to accept or reject the null hypothesis: *„ Creating/destroying value according to the value spread method does not depend on the country of origin of the agricultural company within the observed sample “*. On the given significance level, the null hypothesis was rejected and alternative hypothesis was accepted: it can be said that creating/destroying value depends *on the country of origin of the agricultural company*, within the observed sample. Based on Cramer's V coefficient, the dependence is slightly positive.

Finally, the paper findings have proved that the value spread depends on the country of origin of individual agricultural company; in other words, it can be assumed that the differences among individual agricultural companies in the V4 countries are statistically significant. Moreover, there are 68.6% of V4 agricultural companies do not cover their costs of equity by returns on equity and therefore cannot be objects for income valuation methods.

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KNOWLEDGE MANAGEMENT IN DAIRY HERDS: ACTIONS FOR IMPROVING TIES: THE CASE OF THE 'MAR Y SIERRAS' REGION OF BUENOS AIRES PROVINCE IN ARGENTINA

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Abstract

The dairy sector had a great importance in the livestock economy of Argentina, both in food production and in the social aspect of the labour involved. It is essential to have a level of personal education and adequate training to make decisions that lead to meet the demands. The theoretical framework for studying concept of ties, your advantages and disadvantages had in the communication process in the Argentine dairy enterprise and that are important to the success of knowledge management. This case involves the study of personnel of dairy farms in Mar y Sierras Area (Buenos Aires, Argentina). In effect a total of 49 dairy farms were surveyed between 2007 and 2012, belonging to 40 owners. Social networks and the degree of strength of their ties determine the flow and quality of information and also impact the daily tasks of dairying, these links are formed and disseminated in unexpected ways. In this framework some questions arises: Is it possible to promote such ties? Are these ties generated naturally? From the analysis of the interviews and experience with relevant interlocutors, courses of action it emerges to improve the links between human resources management processes improve knowledge of Argentine dairy systems.

Keywords: dairy farms, knowledge management, argentine dairy systems, communications, ties

"If you want to create a business that lasts a year, cultivated grains,
but if you want it to last a hundred years, grown to your people"
Lao Tse, Chinese philosopher

1. Introduction

The modern dairy is one of the most dynamic agricultural enterprises and has a permanent challenge for technicians, producers and dairy personnel who must handle a major source of information and expertise to achieve greater efficiency and profitability of the system. Moreover, it is known that in milk production there are no holidays, strikes or bad weather, you should always be milking, which is a great physical effort for all stakeholders that should be taken into account when analyzing the company.

To work in a high milk production system, requires, as in any other system of production, labour commitment, perseverance, sacrifice and constant improvement. It should be noted that the "routine work" is one of the most important risks that milk production has, it is perhaps a good reason for the discouragement of people and one of the negative factors of importance when assessing the work of a dairy farm for young people seeking employment. In this framework where efficiency, the predisposition and the training of personnel involved are essential in the dairy production system, we ask:

1) What role do interpersonal ties has in achieving the goals and successes of the strategy?
2) Is it possible to implement measures to strengthen these ties?

In the search for answers, we propose to characterize the dairy personnel of the Mar y Sierras milk area, establishing the methodology to be used, making a bibliographical review to establish the conceptual framework, characterize the ties and its relation with the knowledge management and propose actions to strengthen the ties identified.

2. Feature of human resources from dairy farm on Mar y Sierras area

The dairy sector is of great importance in the country's economy, because it is involved in the food industry and as it requires a skilled workforce, needs a strong interest in the social aspects. The industry represents the 17% of GDP from the national food sector, the third most productive sector in Argentina and the 1.6% of total national GDP (FAO, Cappellini, 2011). It is essential to have a high level of personal education and adequate training to make decisions that lead to meet the demands.

This study was conducted between 2007 and 2012 on 49 dairy farms of Mar y Sierras area, which covers 23 districts of the Province of Buenos Aires (Argentina), consisting of 241 dairy farms, representing 2% of the country's total, producing 4% of the total volume of milk (FAO, Cappellini, 2011).

According to the study, we can infer that the tasks of the staff of the companies surveyed are distributed in Table 1.

Table 1. Time related to the activities

Activity aplication of workforce	Dairy herd	Dairy herd + other activities
Staff Hierarchy (owner, manager)	23.8 %	76.2 %
Nonhierarchical Personnel (tractor driver, bootes, mechanic, manager rearing, inseminator heat detector,	77.3 %	22.7 %

According to the level of education, the staff can be classified as follows, showing a strong emphasis on the poor education of the people (Table 2).

Table 2. Education attained and distribution

Education maximum attained	Distribution
Primary not finished	15.2 %
Primary finished	53.5 %
Secundary not finished	15.6 %
Secundary finished	6.4 %
Terciary	1.2 %
University	8.1 %

Human resources have been involved in different processes in training, with the following distribution (Table 3).

Table 3. Staff involved in specific training for dairying

Personal training processes involved in dairy farms	Distribution
Yes	64 %
No	36 %

In age, the average employee's age was 36 years (median), with a minimum of 23 and maximum of 64 years. 85.3 % of the staff surveyed were male. Marital status: 66.3% were married, 19.8% cohabiting, 11.4% separated and only 2.5% were single. In terms of seniority, the median was 10 years with a minimum of 2 months and a maximum of 45 years.

3. Methodology

Between the years 2007-2012 the multidisciplinary team of researchers from PROANVET (FCV – UNCPBA) conducted closed surveys from dairy farms of Mar y Sierras milk area (Buenos Aires, Argentina). Respondents were business owners, managers and personnel responsible for several tasks of dairy farming work.

Personal surveys were carried out with 329 individuals, with a mean of 6.71 persons per farm (with a median of 7 and a range from 2 to 14 persons).

Closed surveys consisted of 30 questions ranging from data position in the company, seniority, level of education and training, among others, through relationships within and outside the business unit, origin of them, durability and observed changes, to technical details useful for evaluating aspects of productivity and efficiency. These last issues are not discussed in this paper.

The quantitative data analysis was conducted using the Soft Stata with regression analysis and, in case of closed surveys, describing the situation of the activity for Mar y Sierras milk area has relied on the use of Soft Atlas-ti, which has permitted the development of networks with strong conceptual basis in founded theory.

4. Review of the literature

Most dairy cattle farms in Argentina are developed as family businesses, they have several generations of experience. When studying the processes of knowledge management in these companies it is necessary to explain the vision that the owners have for the future and its objectives should clearly reflect its values and ideals.

The explicit objectives often reflect the stages of the life cycle of the owner and his family in the business and agricultural activities cover both itself and the properties in which they have invested.

The challenge for a company with little bargaining power, as is the medium and small dairy farm in Argentina, is to develop appropriate business and achieve aspirations aligned to their human resources in the framework of the proposed strategies.

Operational effectiveness and strategy are essential to superior performance, which after all is the main objective of any company. However, these elements function in very different ways (Porter, 1999). This author's argument was that the benefits of groups derives from the existence of personal relationships that facilitate connections and foster both, open communication and confidence.

There are multiple factors that affect the success of the communication process and the implementation of strategies, such as organizational barriers and the legal forms they assume in the market, the attitudes and behavior of people, generating a culture of trust and commitment, among others. However, there is a need to understand that certain relationships give scope for innovative processes and others, of apparent strength, do not originate them. These elements arise and multiply in interpersonal networks, transcending the boundaries of groups inside and outside the business unit.

It has been established that the strength of a link between different people is the combination of the amount of time, emotional intensity, mutual trust and reciprocal services which characterize the tie (Granovetter, 1973).

There are strong and weak ties across social networks, originating from hierarchical structures, working relationships, formal and informal networks of communication, friendship and/or family, and even those casual ties exists between the people who make up the company.

Karl Weick (1976) suggests that there are loosely coupled systems when they have few common variables are weak, even retain their identity and separation. These weak links are manifested when they occur from time to time, not significantly and indirectly. They suggest that any location in an organization contains interdependent elements which vary in number and strength.

Factors that may lead to weak links can create uncertainty, critical results, the fragmentation of the external environment system, the dispersion of encouragement, bureaucracy, cultural diversity, among others (Weick, 1976).

Knowledge is formed and integrates the resources and capabilities of the company. Lawrence and Lorsch (1967) suggest that "an organization is defined as a system of related human behaviors of people performing a task, to be distinguished from each other by way of subsystems. In turn, these subsystems are integrated to achieve efficient system performance as a whole."

We discuss the effect of factors that this problem generates, but the most important topic is taking an independent position or self-sufficiency of the subsystem.

When, from our role as researchers, studying the processes of knowledge management and its importance in the development of strategies in the agricultural business of dairy farming, we found a very particular world where communication mechanisms are recognized and knowledge transfer represents a real challenge.

One of the important aspects in the study of these agricultural organizations is to analyze the characteristics of the business model of Argentine family dairy farm. The contributions of Max Weber's concept of bureaucracy are very useful in understanding human relationships within the said business model and the legitimation of power based on the family tradition. In this respect Weber argues that the modern bureaucracy model envisages the division of tasks in assigned areas of authority and a clear hierarchical authority headed by the head of the family and the establishment of formal rules and relationships deeply rooted in family tradition.

Tradition is precisely what gives strength, power and authority in hierarchy in the social figure of the family and therefore in the family business.

Argentine laws are based on the Civil Code, which provides a solid legal basis for the figure of "succession" in ownership of the company, without giving way to the possibility of choice, the ability to drive as a good businessman or the real interest of the person who takes the lead, the determinants of candidate selection in the context of the interests of the firm.

Another livelihood to legitimize that authority is the story of family heads leading the direction and decisions of the family business, often at odds with the objectives of both organizations (company/family) and, on many occasions, making the interest of one over the other prevail.

Knowledge is an important strategic resource and not replaceable, which is characterized by heterogeneity and high mobility.

As suggested by Polanyi (1966), this knowledge generator of advantages is tacit knowledge, which is built from experience and plays a key role in the process of learning and value creation. This tacit knowledge, based on the premise that they are shared by people who base their relations on mutual understanding, trust and the sharing of certain rules, beyond the existence of physical proximity between them.

Knowledge management bases its development on the transferability of the implicit or tacit knowledge and converts it into explicit knowledge. In this process linkages are dominant social networks which are the ways where such transfer occurs.

It is therefore vital to establish the degree of importance of the links to understand the behavior of people and their real ability to transfer knowledge, thereby generating outsourcing processes and levels of innovation in the company.

Social networks and the degree of strength of their ties determine the flow and quality of information (Granovetter, 2005). In this framework, we can ask: Is it possible to promote such links or are they generated naturally?

Dairy farming in Argentina is an economic activity, comprising a social phenomenon that is solidified in a series of premises such as habits, tradition or trust.

People who share a daily activity, beyond its location in the hierarchy, are in an environment in order to improve and strengthen relationships of trust mechanisms. This scenario has been called embeddedness (Granovetter, 1983).

The concept of trust which will have an important role in defining the mechanisms of communication, inward or outward from the company, as studies such as Katz and Lazasfeld, 1955 (quoted in Granovetter, 1973) have established that communication processes based on personal ties are more effective than massively distributed information and that which does not know its origin and authenticity. So if you can set and measure confidence in a leader, we retrospectively establish the ability to predict and affect the behavior of the subordinates of the company.

5. Strong ties and the strength of weak ties

When analyzing organizations from the point of view of sociological theory, the concept of link or loop has been suggested to establish two types of social networks involved in the processes of diffusion of knowledge (Granovetter, 1973).

Firstly an interconnected network shows the existence of many relational lines, giving rise to the so-called strong links, and secondly a low density network consists of relational lines existing between individuals and the group of acquaintances, giving rise to the so-called weak links.

It has been argued that those with few weak links have an important restriction on access to information from the social system and in cases of initiatives to get a new job, may be disadvantaged in the labour market, either because they are isolated from new ideas or fads, or ignorant of the current job openings at the time of the search (Granovetter, 1983). It is precisely this type of bond that allows a greater flow of information between groups, serving as a bridge to link and giving a sense of community.

In line with this position, it has been suggested that strong ties may provide access to redundant information (Hansen, 1999), but from the existence of weak ties that greater and updated information, one that leads to processes of innovation and move in circles outside by itself, have access to information other than that which is usually accessed.

The generators of weak links are groups that share work duties and formal organizations, including those where the object is recreation.

When in the agricultural enterprise we face heterogeneous groups, often formed by way of different business units (e.g. Dairy A, Dairy B), weak ties can be achieved to facilitate the communication processes of knowledge, and even get to act intergroup bridges as true, as the context permits training the people involved. In that sense it is suggested that the links between people without links to others are called local bridges (Feld, 1981).

For these reasons, and in line with what is suggested by Granovetter (1983), weak ties may be more useful for the purposes of the individual and the organization, if they have the strength to become useful bridges rather than become strong links.

Some academics (Granovetter, 1983; Wegener, 1991) argue that weak ties have the disadvantage of limiting access to information by individuals, or at least be less efficient under certain circumstances and therefore are disbelievers of volume and quality of the information circulated through them. That is why the dependency relationships with friends or individuals deeply rooted links tend to be more successful in the process of covering a labour need.

Other authors suggest that the complex processes of information flow, even when dealing with tacit knowledge, the effectiveness of weak links is questioned (Teece, 1977; Hansen, 1999).

An issue related to the promotion of ties has to do with the cultural differences of the individuals involved and the associated costs to maintain over time such links or ties, to which the scientists suggest that strong ties undertake higher costs, since they rely on the base formed by the permanent interaction between people, usually those who are called friends.

So frequent visits or meetings require sacrifices, not only of money, but of valuable time and generate reciprocal obligations whenever some vital information is entrusted to us.

According to the last paragraph, and to the extent that those obligations of reciprocity become more enforceable, a strong bond can become an obstacle for the company as you run the risk of losing the necessary autonomy in innovation processes.

6. Knowledge management and its relationship with links

In an organization, such as the dairy farming operation in Argentina, the fact that learning involves the existence of different ways to construct and organize knowledge and/or routines around their activities and within culture, provides a gradual recognition of this process, its activities and results, as contributing to the establishment and maintenance of a competitive advantage. Knowledge is recognized as the most important result of organizational learning (Senge, 2000).

There are several theories to explain the processes of knowledge management, but one can understand the process of knowledge generation and transfer through the so-called spiral of knowledge conversion (Nonaka and Takeuchi, 1995).

It will be the aim of this dynamic process called spiral, converting tacit knowledge into explicit knowledge so that it can be properly disseminated and support innovation processes in the company. The knowledge creation process requires a specific context in terms of time, space and relationships to sustain (Nonaka et al, 1998).

Thus the activity and relationships of people and organizational culture permit this context or setting, generate power, quality and better spaces for individual development in converting information into knowledge through the spiral and that new knowledge is created from existing knowledge through the exchange of meanings and contexts.

Here the need for greater understanding of how the organization and the individual come to have shared meanings appears, which are key elements of organizational culture and in turn, required for the successful implementation of strategies. In this context, the recognition of the existence of tacit knowledge and the existence of ties or links, whether strong or weak, play a role in the process and can ensure, or not, the success of these business strategies.

The current development of communications, bureaucratization, the population density and the number of human resources involved in economic activity, promote an increase of a larger number of weak ties.

7. Actions to strengthen the ties

The great advantage of working with agribusiness personnel is its high susceptibility to training, either by their low level of study or social. The study provides very encouraging data (see “Personal Features ...”), since a high percentage of respondents (64%) are prone to training.

Another point to note is that only 9.6% preferred individual training, which shows that 90.4% opt for training in groups. Regarding the place, 78.4% preferred that the training takes place outside the scope of work, for example in the University.

Through training, re-training, team building, research and support of a leader, the power supply with technical meetings, with prizes and, above all, by creating welfare for workers and their families, strengthen linkages are achieved and improve knowledge management processes.

These tasks, which seem so far removed from the administration and management of a dairy stream, have become necessary and intensification of production systems makes it unavoidable.

Some of the issues on which one can work on training projects are illustrated in Table 4, representing six common objectives for dairy enterprises with their specific actions.

When operated from the outside, where what is done is determined and controlled by external factors such actions involve a negative effect, the person is on the defensive, hesitant, does not take risks and is unmotivated.

Conversely, when actuated from inside, driven behaviour causes the internal and personal control activity results charged. The person is more optimistic, confident, accepting the risks better, so we say the person is motivated.

Table 4. Common targets for dairy farms and actions

KNOW-HOW **Skills and talents to the required task** * staff training * specialization of tasks * interaction with the university * owner's training	**STRATEGIC INFORMATION** **Knowledge management** * use of supporting documents * access to computer technology * management of periodic reports	**CULTURE** **Internationalization of the vision and mission. Mind model** * open mind * demonstrate values- * set an example
LEADERSHIP **Mobilizing leader** * humility * recognition of achievements * assess the availability	**ALIGNMENT** **Empowerment** * families job * approach to strategic partner * administration of expectations * identity of the job	**TEAMWORK** **Share knowledge Team spirit** * good practice shared * availability for work * Argentine barbecue

8. Conclusions

From the study in relation to a number of dairy farms in the Mar y Sierras area in Argentina it has been shown that there are multiple factors that affect the success of the communication process, where organizational barriers, attitudes and behavior of people, generating a culture of confidence or commitment can give rise to links that will support knowledge management processes (Granovetter, 1983).

These linkages can be strengthened by the creation in human resources for better working conditions and promoting training opportunities. The paper suggests some actions that serve as a trigger of training processes in the conviction that there is a high staff predisposition to it.

There are different ways to train, although it is advisable to “empower” staff, it is also necessary to enable them to reduce the risks of having and using that power. Bad technical decisions directly affect the costs and results of the company.

There is, in any person, an innate desire to learn. Often this desire is hidden and the lack of motivation prevents its manifestation. But it is also true that the right work is enjoyed for its own quality and it should point to who wants to work with motivation and efficiency. Those eager to learn and to know are the best target to achieve in formal education of any person.

It bears repeating that the training should be continued, the widespread custom of sending staff to a technical talk and consider a course or have already received sufficient instruction on how to do things is wrong. Only supported with lessons to everyday work will make it in efficient and also each training will be a motivating injection. Staff should feel supported, supervised and motivated, if you feel your job is important in itself you will want to do well.

We can say that an organization, with the features described in this paper, can learn which suggests that to sustain the climate of organizational culture that allows innovation spaces achieve an effective knowledge management process, the organization must learn from and of this cultural perspective focus for their efforts on creating mutual support and shared meanings (Schein, 1988).

Finally we must make clear that the development of the conceptual frameworks of this study require the necessary complement of empirical research to validate the claims above, in reality the process of knowledge management in the dairy farming operation in Argentina, to abandon what would a speculative vision of the sector. Empirical models have been developed by Noah Friedkin (1980) and Scott Feld (1981), which establish the structural meanings of weak links and strength in the context of social networks investigated.

These results are encouraging, but are considered inconclusive, so the door is open for future development of new research to illuminate the issues raised.

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MORE THAN INCOME BENEFITS? THE IMPACT OF FARM INVESTMENTS ON FARMERS' PERCEIVED QUALITY OF LIFE. EVIDENCE FROM AUSTRIA

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Abstract

The evaluation of farm-investment programmes is a challenging task, since investments and the effects caused by investments are very heterogeneous. Investments do not only have purely economic effects such as income augmentation and workload reduction, but they also influence farmers' quality of life. In our study we analyse 23 typical agricultural investment projects in Austria and we investigate the impact of those investments projects on farmers' perceived quality of life. The findings show that the farmers pursue multiple objectives with their investments. The investment projects contribute positively to farmers' satisfaction with quality of life; this applies particularly for labour-intensive dairy farms and for life domains such as work, income and leisure time. We conclude that the application of QOL-indices significantly broadens our understanding of investment processes and we recommend integrating such an indicator into future investment project evaluation.

Keywords: farm investment, investment behaviour, quality of life, mountain farming

1. Introduction

The Austrian farm-investment support programme is a part of the second pillar of the CAP. Apart from improving working conditions, animal welfare and environmental conditions, it aims particularly to improve the competitiveness of farms and to safeguard agricultural incomes. Recent econometric studies on the economic effects of the farm-investment support programme show that income-raising effects of the measure are limited (Kirchweger and Kantelhardt, 2012; Ratinger et al., 2012). However, this does not mean that investment programmes do not work properly but rather it indicates that profit maximisation is not the only objective that farmers pursue.

Gallerani et al. (2008) outline in their review of the literature on farm-investment behaviour that farm-investments relate to a large number of socio-economic issues. In marginal regions, as we find them e.g. in the Austrian Alps, farm-investment decisions are even more difficult to explain by mere profit maximisation. Other objectives such as improving quality of life by reducing workload may gain in importance in such regions. Källström (2002) points out that farm life nowadays also has to cope with changed norms of society. Farmers subjectively value the qualities of farm life. If these qualities, however, cannot hold up against the farmer's valuation of societal norms, such as financial position, vacation or family life, farmers may take decisions to change their way of life. In its most radical form, this may be the decision to quit farming (Källström and Ljung, 2005) or, from a successor's perspective, not to take over the farm.

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It becomes clear that the creation or the safeguarding of a certain level of quality of life (QOL) is of high importance. This applies also to farm-investment support programmes which show a high potential for shaping farm endowment in a way that working conditions are highly acceptable for farmers and consequently contribute to a good QOL. If programmes have the potential to influence positively the farmers' QOL, this may also contribute to ensuring comprehensive land use, even in marginal regions. However, in order to consider QOL in political programmes, appropriate indicators are necessary. The main objective of our study is to develop such an indicator and apply it to 23 Austrian farm-investment projects. Furthermore, we compare the result of our QOL estimation with the total household income change in order to identify possible correlations between these indicators.

The remainder of this paper is organised as follows: the next section gives an overview of QOL literature. The methodology and the data basis are introduced in Section 3. In Section 4 we present the main findings on QOL in agriculture and finally we discuss our results and draw some conclusions on future research in the concluding section.

2. Quality of life

QOL is a relatively young concept. First surveys on QOL were conducted in the mid-sixties, although the term QOL was first mentioned in 1920 by A.C. Pigou. Pigou defined QOL as 'non-economic welfare'. Nowadays QOL has become a popular theoretical construct in social sciences and numerous definitions can be found in literature (Felce and Perry, 1995; Quendler, 2011). Furthermore, literary analysis shows that there is an overlap between the term QOL and other, quite similar terms such as happiness, life satisfaction and well-being.

In the last years three principal QOL-research trends have emerged:

1. The first approach is the objective approach. It uses aggregate social indicators, which are external to the individual, to measure QOL (Arbuckle and Kast, 2012). One example for such an indicator is income. Indicators can be simultaneously observed by other people than the individual itself (Bogue and Phelan, 2005).
2. The second approach is based on an individualistic conception of QOL. This subjective perspective of QOL emphasises the individual's perception of its condition in life (Arbuckle and Kast, 2012). Subjective indicators aim at the values and attitudes of individuals. Indicators can furthermore be divided into two groups: the first is a set of global indicators which assesses living conditions in general, e.g. satisfaction with life. The second group relates to individual life domains, e.g. satisfaction with work. As Cummins (1996) underlines, 'the great majority of more recent definitions, models and instruments have attempted to break down the QOL construct into constituent domains'.
3. The third approach is very common in German-speaking countries and tries to combine both approaches (Quendler, 2011). Diener and Suh (1997) outline that objective social indicators and subjective well-being measures may only modestly correlate. Therefore, the authors note the complementary nature of both approaches.
4. In the context of agricultural research, numerous studies on perceived quality of life were conducted in the course of the U.S. Farm Crisis of the 1980s. Several studies (in particular Molnar, 1985) examined the impact of structural factors such as income, farm size and employment on subjective well-being. Studies succeeded in detecting a correlation - at least shortterm - between total household income and QOL. However, there was no correlation found between QOL and farm income (Molnar, 1985; Coughenour and Swanson, 1992). This

might be explained by the fact that farmers perceive their work both as business and a way of life (Coughenour and Swanson, 1988) and economic and non-economic rewards, such as QOL, contribute to satisfaction with farming. A recent study by Arbuckle and Kast (2012) concludes that positive assessments of quality of life among farm families depend strongly on non-farming domains of their life. In this context the authors underline the growing importance of off-farm employment in order to maintain QOL.

3. Method and data

3.1. Structure of the survey

Our survey is based on a survey approach of Radlinsky et al. (2000) , who conducted a survey on the QOL of Swiss Agriculture. The Swiss researchers developed in their work a 'quality of life index' (QLI), which is in line with the subjective QOL-model of Campbell et al. (1976). Consequently it measures subjectively perceived satisfaction with objectively measurable life domains. One advantage of this approach is that it implements experiences which are important to the individual. However it should be emphasised that self-reported measurement values may be subject to biases.

Our QLI comprises 10 life domains, namely 'working on one's own farm', 'amount of education', 'income', 'standard of living', 'family life', 'social environment', 'political and economic conditions', 'leisure time', 'health' and 'values and religion'. The interviewees were asked to rate their satisfaction with each area of life by using a five-point Likert scale, ranging from 'very dissatisfied' (1 pt) to 'very satisfied' (5 pts). As we wanted to measure the development of QOL, we asked interviewees to indicate their level of satisfaction at two different points of time, one prior to the investment and one after the investment (at the date of the survey). Since individuals do not attach the same importance to each life domain, interviewees could weigh the domains by evaluating them. The 5-point Likert scale ranges from 'very unimportant' (1 pt) to 'very important'(5 pts). The importance of each life domain is supposed to be constant over time.

The QLI is calculated as the sum of the products of the satisfaction and the importance of each life domain.

$$QLI = \sum i_{ld} * s_{ld}$$

Where:
i_{ld} = importance of certain life domain
s_{ld} = satisfaction with certain life domain
ld = life domain ('working on one's own farm', 'life standard', 'family life', …)

The interviews with the farmers took place in early 2012. In order to guarantee a profound experience of interviewees with farm-investment activities we considered only farms which invested in a period of three to five years prior to the survey. It should be noted that we conducted the survey in the context of a general evaluation study of the Austrian farm-investment support programme 2007-2013. Besides a statistical analysis of the farm-investment programme, case studies of typical investments highlighted the motives and the objectives that farmers pursued with these investment projects. The semi-structured questionnaire covered different topics ranging from the socio-economic data of the farms, through changes of the farmer's workload to the farmer's perceived quality of life.

3.2. Description of the farm sample

The participating farms represent typical Austrian farms and investment projects and were selected in co-operation with the Austrian Ministry of Agriculture. Our sample comprises 23 family farm-investment projects. As Figure 1 shows, we considered projects from a wide area and we integrated all relevant farm types into our study.

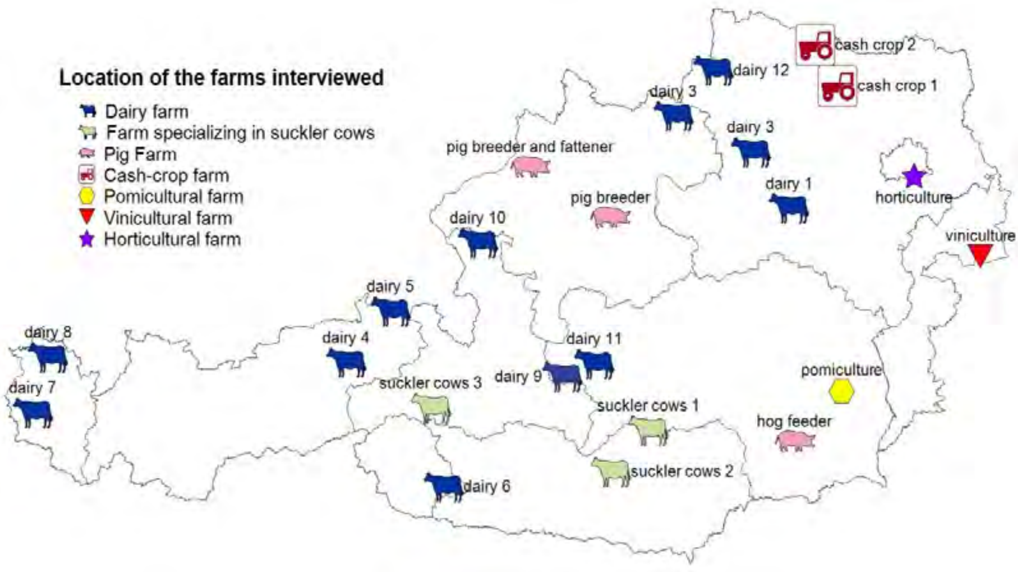

Figure 1. Location of the farms interviewed

Table 1 gives a more detailed overview of the 23 sample farms. Net investment costs of the surveyed projects range from € 12,000 up to € 470,000. The farmers pursued various objectives with their investment projects. The goals can be classified into three groups: (i) economic goals (e.g. business growth, maintenance of income level); (ii) goals concerning workload (e.g. better working conditions, reduction of working time); and (iii) necessary adjustments due to amended statutory provisions (e.g. animal welfare directive, organic guidelines).

A closer look at the surveyed investment projects reveals that the projects are very diverse: for instance, three dairy farms follow a growth-orientated strategy with their investments. They raised the herd size and invested into modern technology such as milking robots. Three further dairy farms converted from stanchion barns to free-stall barns in order to improve working conditions. Pig fattening farms invested in new stables, the vinicultural farm and one cash-crop farm built storage buildings.

Table 1. Overview of surveyed farms

Farm	Description	Investment project	Capital Cost	Primary aim of investment
dairy 1	Specialised grassland farm	New construction of free-range barn incl. milking robot, 2008	€ 445,000	n/a
dairy 2	Specialized grassland farm	Expansion of free-range barn incl. milking robot, 2008	€ 470,000	Business growth
dairy 3	Specialized grassland farm	Expansion of free-range barn, 2007	€ 300,000	Additional income
dairy 4	Mountain farm	Reconstruction of a barn, adaptation into free-range system	€ 285,000	Better working conditions
dairy 5	Mountain farm	Construction of an mountain barn	€ 250,000	Higher working productivity
dairy 6	Mountain farm	Adaption of a stanchion barn	€ 175,000	Better working conditions
dairy 7	Specialised grassland farm	New construction of free-range barn	€ 500,000	Better working conditions
dairy 8	Mountain farm, Vorarlberg	New construction of free-range barn	€ 300,000	Ease of physical work
dairy 9	Mountain farm	Adaption of a stanchion barn	€ 100,000	Reduction of working time
dairy 10	Specialized grassland farm producing pasture milk	Hay ventilation system	€ 35,000	Better working conditions
dairy 11	Mountain farm, Styria	Alpine forest road	€ 20,000	Maintenance of income level
dairy 12	Mixed farm, converting to organic farming	Runout for cattle	€ 12,000	Better working conditions
Suckler cows 1	Mountain farm, specialised on forestry	Expansion of free-range barn by an outside lying area incl. hayloft	€ 62,000	animal welfare directives
Suckler cows 2	Mountain farm, off farm employment	New construction of a free-range barn incl. hayloft	€ 240,000	Maintenance of income level
Suckler cows 3	Grassland farm specialised in direct marketing	New construction of a free-range barn	€ 320,000	Business growth
Pig breeder		New construction of a breeding stable	€ 164,000	Additional income
Hog feeder		Feeding stable	€ 300,000	Creation of new family job
Pig breeder and fattener		Modernisation and expansion of barns	€ 261,000	Maintenance of income level
Cash crop 1	Organic cash crop farm,	Storage building	€ 256,000	n/a
Cash crop 2	Organic cash crop farm,	Crop silo	€ 78,000	Reduction of working time
Pomiculture	Pippins	Apple trees,	€ 106,000	Maintenance of income level
Viniculture	Mixed farm (cash crops, horticulture, viniculture)	Wine cellar and storage building	€ 350,000	Maintenance of income level
horticulture	Tomatoes,	New construction of a glass house	€ 250,000	Maintenance of income level

4. Results

A first result of our survey is that farmers clearly associate with the term 'quality of life' the term 'freedom', which goes with being a farmer: They highlighted that their job (still) offers 'a kind of independence' and that they can be 'their own boss'. They can work and live 'in accord with the natural seasons' and they cherish having the opportunity to 'bring up their children in the countryside'. This positive appraisal of farm life is also reflected in the future perspective, which all farmers estimate as rather positive up to clearly positive. Furthermore it becomes clear that the majority of the farms (19) do not pursue the goal of accelerated growth with investments, but rather plan to secure the existence of their farms.

Figure 2 displays how farmers (n = 23) score the different life domains. Size and position of the bubbles indicate the importance that farmers assign to the various life domains. All domains are rated on the scale between *rather important* (+1) and *very important* (+2), whereas '*work on one's own farm*', '*health*' and '*family life*' are valued most important. '*income*' as well as '*political and economic conditions*' achieve only medium importance.

The lines in Figure 2 show farmers' satisfaction with each life domain. The green broken line indicates perceived satisfaction prior to investment and the red continuous line is perceived satisfaction after investment. It becomes clear that farmers succeeded in increasing their satisfaction particularly in those domains which are of high importance for them. The highest increases can be observed in the following three life domains: '*Work on one's own farm*' rose on average by 0.70, '*income*' by 0.57 and '*leisure time*' by 0.48. These life domains clearly correlate with the aims that farmers declare to pursue with their investments.

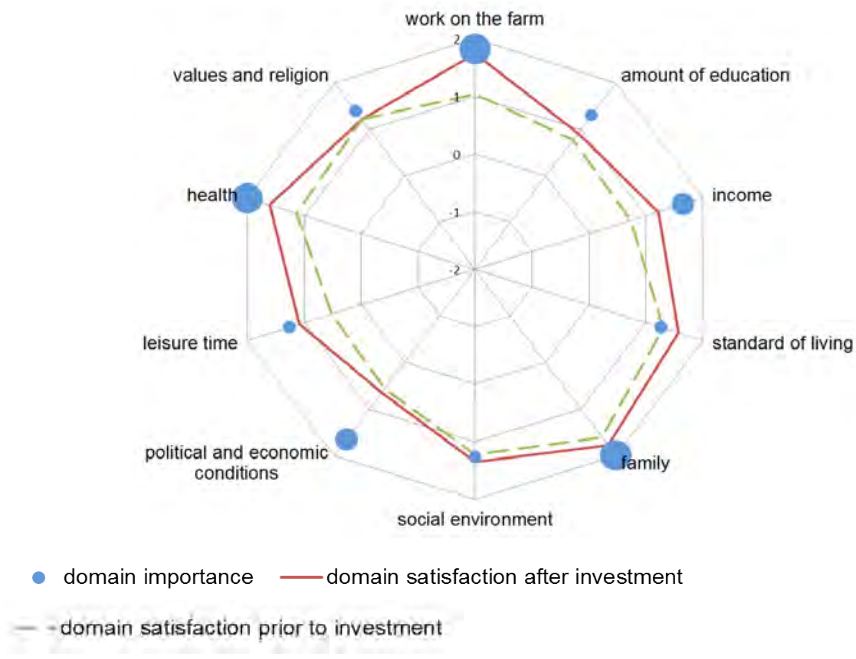

Figure 2. Medium differences in QOL in the course of farm investments (n = 23)

As the next step, we collate the importance of and the satisfaction with the various life domains into one single value, the Quality-of-Life Index (QLI). Figure 3 shows the development of the QLI over time. A total of 19 of the 23 interviewed farmers succeed in increasing its QLI. Dairy Farm 10 has the highest increase, which might be explained by the extraordinary positive impact of the new hay ventilation on the alleviation in the allergic discomfort of one family member. The investment of Dairy Farm 1 increased the farmer's QLI by 23%, which is mainly caused by the farm family's gain in leisure time due to the new milking robot.

In general, non-dairy farms have a smaller QLI increase than dairy farms. Cash crop 1 as well as pig breeder and fattener stay fairly constant, since the QLI-level is already high prior to investments. However, these farmers pursued goals different from QLI increases. The QLI of the pomicultural farmer shrunk in the course of investing. This is mainly caused by the fact that the farmer is increasingly discontent with the political and economic situation of agriculture.

Figure 4 shows the correlation between the relative QOL change and the relative change of total house income before and after investment. Due to missing accounting data, only 17 of the farms can be considered. As the figure already illustrates, there is no significant correlation between income changes and QOL changes. Eight farms show an increase in QLI as well as in total house income. In contrast to this, six farms are more satisfied with their life despite decreasing income.

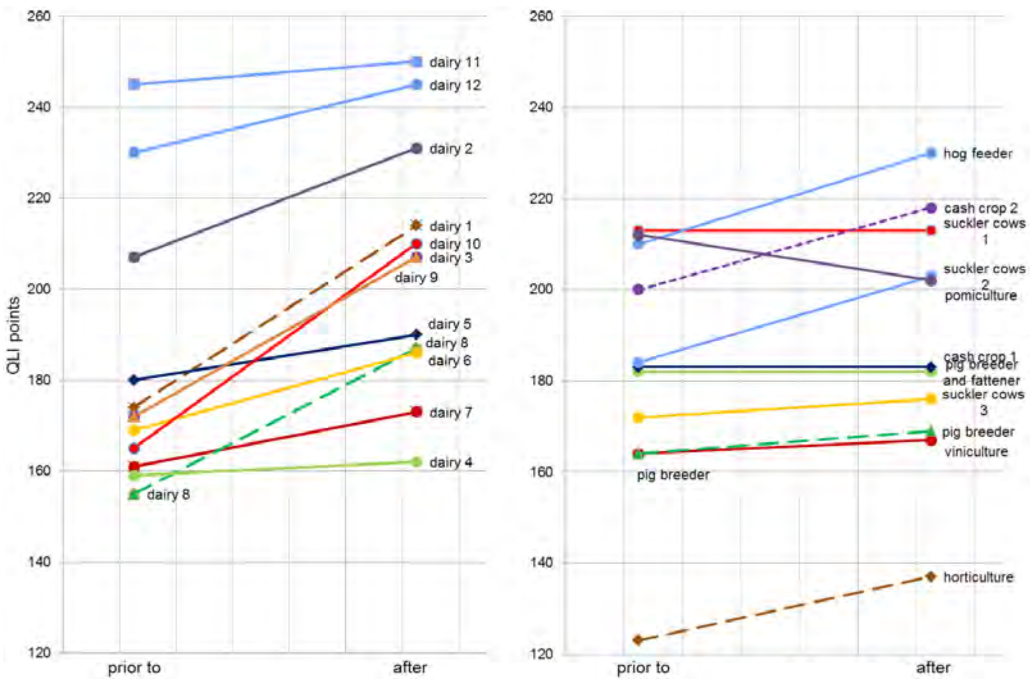

Figure 3. Development of perceived QOL prior to and after investment on the 23 farms interviewed

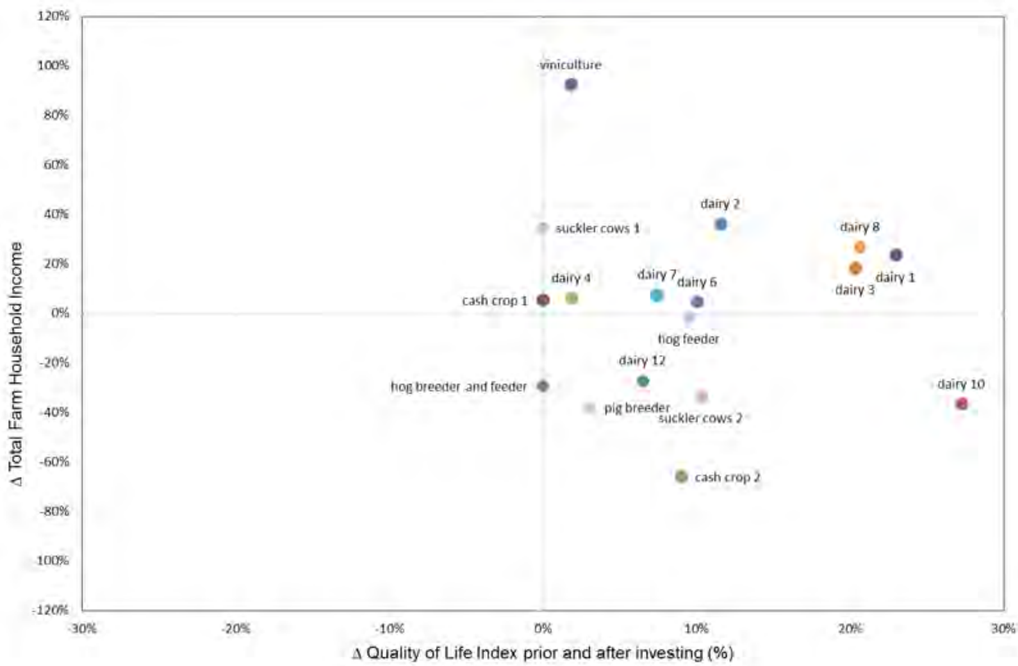

Figure 4. Relative changes in total farm household income and QLI in the course of investing

5. Conclusions and proposal for further research

The results of our study show that the analysed investments have on average a positive impact on the farmers' perceived QOL. However, results are quite heterogeneous: in particular, labour-intensive dairy farms succeed in realising an increasing QLI, while QLI increase is for other farm types moderate or, in one case, even negative. Important life domains from the point of view of farmers are 'work on one's own farm', 'health' and 'family', the highest increases in satisfaction can be observed in the life domains 'work on one's own farm', 'leisure time' as well as 'income'.

Due to the small number of interviewed farms, this study only roughly indicates changes in QOL. In order to investigate the effects of investments on QOL it is planned to establish a follow-up study, which will quantitatively analyse whether the observed trends are generalizable. Moreover, our study indicates that it is necessary to enhance the QLI in order to become an additional instrument for measuring success and efficiency of farm-investment programmes. The QLI could consequently be used – beside classical indicators such as income augmentation – as a decision-support instrument for the future shaping of investment programmes.

In conclusion, we can say that the application of the QLI significantly broadens our understanding of investment processes. Therefore, we can recommend integrating such an indicator into future investment project evaluations.

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GHG EMISSIONS FROM AGRICULTURALLY MANAGED PEATLANDS – EMISSION MITIGATION VERSUS MICROECONOMIC INCOME EFFECTS

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Abstract

Increasing Greenhouse-gas emissions and related climate effects require mitigation strategies. Also emissions caused by agriculture are brought into the focus of political debate. Particularly peatland cultivation, inducing significant CO_2 emissions is being discussed more and more. Our study aims to answer the question of whether changes of peatland management can serve as cost-efficient emission- mitigation strategy. We have built an economic model in which farm-individual and plot-specific CO2-abatement costs of selected landuse strategies are calculated by contrasting effects on the agricultural income with the related reduction in greenhouse-gas emissions. With respect to microeconomic data we use a dataset collected in six German regions while data on emission-factors originates from own measurements. Results show that CO_2-abatement costs vary due to different levels of land-use reorganisation. Reasonable emission reductions are mainly achieved when agricultural intensity is clearly decreased. Agricultural income forgone varies significantly due to production conditions and mitigation strategies. However, even when economic costs are high they may be balanced by high emission reductions and may not result in high abatement costs. Nevertheless, CO_2-reductions benefits appear to be social and costs private. Agro-environmental programmes must be implemented to compensate resulting income losses.

Keywords: agricultural GHG emissions, agricultural CO_2 mitigation cost, climate-friendly peatland management

1. Introduction

The increase of carbon dioxide emissions and the resulting effects on the climate are at the heart of political discussion. Agricultural production, as a major source of greenhouse gases (GHG), is increasingly put into focus and the question is raised how agriculture can contribute to emission-mitigation. The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) specifies that the most prominent options for GHG mitigation in agriculture are improved crop- and grazing-land management (e.g. nutrient use, tillage, etc.), the restoration of degraded lands and the restoration of peatlands drained for crop production. (Smith et al., 2007) Our study focuses on the last of these alternatives. Peatlands have stored carbon over centuries, as under flooded conditions soil-decomposition is suppressed by the absence of oxygen. Cultivation and draining of peatlands initiates the process of decomposition; large fluxes of potential GHGs going back into the atmosphere are the consequence (Smith et al, 2007). In Germany emissions from drained peatlands account for 5,1% of overall German GHG-emission and are the largest single emission source outside the energy sector (NIR, 2010). As regards agriculture, cultivated peatlands contribute with 30% to the overall agricultural emissions while covering only 8% of the Utilized Agricultural Area (UAA) (cf. Byrne et al. 2004; Hirschfeld et al., 2008). Consequently, by focusing only on peatlands, agriculture could reduce its emissions significantly while production on only few UAA was affected.

In our study we model GHG-fluxes of representative land-use strategies and derive climate friendly management recommendations. To analyse whether our recommendations are cost-efficient, we model farm- and plot-specific income effects resulting from the implementation of the recommended strategies and contrast them with the related reductions in greenhouse-gas emissions. We conduct our study in five German peatland regions, described in Chapter 2. Chapter 3 introduces our database and method while the results of our study are presented in Chapter 4. Here we show the economic consequences and cost efficiency of different measures considering the impact of regional conditions. When discussing our results in Chapter 5 we widen our perspective and compare the performance of our study objects with results from non-agricultural fields. A conclusion is drawn in Chapter 6.

2. Regions of study

Our study regions represent typical natural and agro-economic conditions in the north-west, east and south of Germany. R1 is a bog covering about 4,000 ha; peatland is exclusively used as intensive grassland for forage production for dairy cattle husbandry. R2 consists of bog and fen sites covering 6.000 ha. Agricultural land is used by intensive pig-fattening farms for the production of mainly maize for forage and biogas. R3 stands for an extensive fen region covering ca. 30.000 ha. R4 is a fen site fed by a continuous groundwater stream with an extension of about 600 ha. In R3 and R4 agricultural land-use ranges from low to high intensive grassland for suckler cow and dairy cattle husbandry; furthermore peatland is used as arable land for cash crop, energy-crop and forage production. R5 is representative for bog and fen-sites at the foothills of the Bavarian Alps, peatland is exclusively used as low- to medium-intensive grassland for forage-production for dairy cattle husbandry.

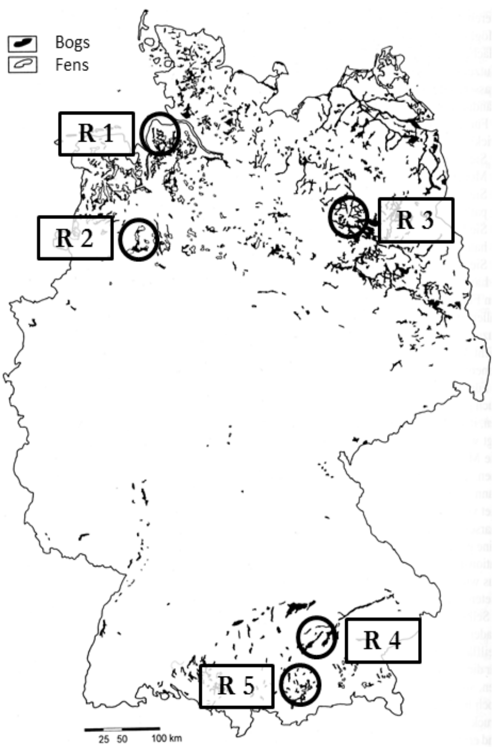

Figure 1. Location of the study regions in Germany (modified from Schopp-Guth 1999)

3. Method and database

Data to identify potential climate friendly landuse-strategies originates from own measurements of GHG-fluxes of common land-use strategies. Measurements are conducted in all regions using portable and automatic chamber systems described in Drösler (2005). The measurements consider fluxes of carbon dioxide- (CO_2), methane- (CH_4) and nitrous oxide- (N_2O) and the import and export of C. On basis of the measurements, we model Global Warming Potentials (GWP) (measured over the timescale of 100 years) for different land-use strategies (Droesler, 2005; Förster, in prep.). Consequently, the mitigation potentials of management changes are determined by comparing the specific GWPs of the single land-use types. Analysing the extent of mitigation achievable, recommendations of relevant climate-effective land-use conversions are developed.

The economic database to calculate farmers' income forgone we collect in comprehensive regional farm surveys, described by Schaller & Kantelhardt (2009). To calculate microeconomic costs we analyse annual agricultural income forgone resulting from a change of value added on the peatland sites. We carry out farm-individual and plot-specific calculations of "gross margin" for market-crop production and "processing value" for forage production, described in Schaller et al. (2012). To identify cost-efficient strategies of climate-friendly peatland management, costs of GWP reduction for the chosen land-use strategies are calculated. For this, we contrast income forgone with the related reduction in greenhouse-gas emissions. (Schaller et al., 2012)

4. Results

Our results show that achievable GHG-mitigations directly depend on the height of the groundwater tables: Peat profiles with high water tables are characterised by mainly anaerobic conditions, while aerobic conditions are limited to a shallow upper layer. With low water tables the aerobic zone in the profile extends, resulting in rising soil respiration and mineralisation. The degradation of the carbon and nitrogen stocks in the peat transforms the peatland from a C and N sink to a potentially very strong C and N source in terms of CO_2 and N_2O emissions.

Consequently, agricultural land-use types necessitating the lowest water tables, namely arable land and high-intensive grassland, are accompanied by the highest emissions. Significantly lower emissions occur on grassland sites with high water tables, managed with low agricultural intensity (1 to 2 cuts) or kept under maintenance. Quasi zero emissions occur on sites which have been restored by withdrawing any land use and enhancing the water table to an annual average of about 10 cm below ground surface. Flooding of peatlands in contrast is a "suboptimal" restoration

Table 1. Average GWP for different peatland-and landuse- types (Minimum to Maximum) [Number of study regions]

	Fen	Bog	Watertable
	$tCO_2 - Aq/ha \cdot a$		cm
Arable land	33,8 (14,2 to 50,0) [4]	No data	-70 (-29 to -102)
Grasland Intensity middle/high	30,9 (21,3 to 40,7) [5]	28,3 [1]	-49 (-39 to -98)
Grassland Intensity low, dry	22,5 (19,5 to 30,9) [4]	20,1 [1]	-28 (-14 to -39)
Grassland Intensity low, wet	10,3 (5,8 to 16,3) [4]	2,2 (0 to 4,4) [2]	-11 (6 to -25)
Close to nature/restored	3,3 (-4,3 to 11,9) [5]	0,1 (-1,8 to 2,9) [3]	-10 (-7 to -14)
Flodded conditions	28,3 (10,6 to 71,7) [4]	8,3 (6,2 to 10,4) [2]	14 (-8 to 36)

measure, as high emissions of CH_4 outnumber savings on C and N and lead to high GWPs (see Table 1). The results suggest that only a significant enhancement of the water tables and – as a result – a drastic reduction of agricultural intensity lead to significant emission reductions. High mitigation potentials are seen in a change of arable land and intensive grassland into "wet" grassland kept under maintenance measures or the change from agricultural land use to complete and adapted restoration – resulting in complete abandonment of agriculture (Figure 2).

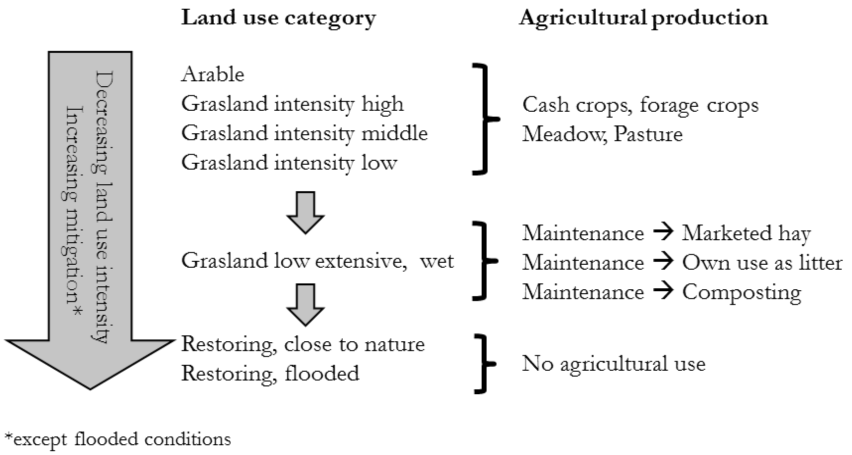

Figure 2. Recommended land-use changes

How strong such mitigation steps impact on the micro-economic situation of affected farms depends on the farms' current organisation and management strategies and the amount of area affected. In our study regions, substantial differences in farm organisation and type of farming are observable. While R1 and R5 are pronounced dairy cattle regions, the great diversity of farming types managing peatland area becomes obvious when looking at R2, R3 and R4. Also the management of peatland varies clearly: while in R1 and R5 peatland is basically used as grassland, in R2, R3 and R4 a high percentage of peatland area is used as arable land for forage and cash crop production. As regards grassland use, R1 and R5 show the highest intensities to produce the quantity and high quality of forage needed in dairy cattle production (see Table 2).

Along with the differences in farm organisation and management strategy, value added on peatland sites varies significantly (see Table 3). As regards values generated via animal husbandry, the primary causes of variety are the different types and intensity levels of animal husbandry. Processing values on intensive area in R1 and R5 is exclusively derived from gross margins of dairy-cattle husbandry: high levels of milk performance creating high gross margins per dairy cattle, combined with high level of land-use intensity, allowing for feeding more than one dairy cattle per hectare, lead to high value added on forage sites; outstanding performer is arable land used for silage maize production for dairy cattle husbandry. In regions like R3, where processing values are driven by animal husbandry creating lower gross margin (e.g.: cattle fattening, suckler cows, dairy husbandry with lower milk performance) the value of forage area consequently is lower.

Table 2. Characteristic of agriculture in the study regions

Farm organisation, type of farming (%)	R1	R2	R3	R4	R5
Full time farms	100	100	95	95	86
Organic farm:	-	-	10	26	19
Specialist field crops	-	-	15	26	-
Specialist granivores	-	70	-	5	-
Specialist dairying	100	20	30	32	86
Cattle fattening	-	5	-	5	-
Suckler cows	-	-	15	-	10
Mixed livestock/field crops	-	5	35	21	-
Non classifiable	-	-	5	11	5
Peatland use (% of peatland total)	R1	R2	R3	R4	R5
Arable forage	1,5	28	19,5	17	1,5
Arable cash crop	-	2	20	20	-
Grassland intensity high	73	11	5,5	20	41
Grassland intensity moderate	20	8	30	21	9
Grassland intensity low	5,5	51	25	20	2
Litter meadow	-	-	-	2	46,5
Average farms' peatland area (%)[1]	89	53	63	36	27

[1]Share of peatland in the interviewed farms‘ total UAA

Table 3. Average value added of forage-and cash-crop land-use types (€/ha*a)

Landuse-types	R1	R2	R3	R4	R5
Arable exclusively forage[2]	3.877	1.414	2.039	2.868	3.366
Arable exclusively cash crops[3]	-	840	346	464	-
Arable forage/cash crops[4]	-	946	750	1.275	-
Grassland intensity high	1.894	2.773	1.631	1.526	1.837
Grassland intensity moderate	1.706	2.201	1.207	851	930
Grassland intensity low: (agricultural utilisation)	867	612	681	479	763
Grassland intensity low: (maintenance hay)	388	388	336	390	-
Grassland intensity low: (maintenance litter)	-	-	-	-	213
Grassland intensity low: (maintenance compost)	158	158	106	161	161

[1]weighted by amount of area, area payment included (federal target values 2013), cash-crops include winter wheat, winter barley, summer barley, winter rye, corn and oat, considered are machine costs, costs of harvest, costs/profits of product utilisation (eg, composting or marketing of litter or hay);
[2]PC values of arable land of farms carrying out exclusively forage production on arable land (silage, maize)
[3]GM values on arable land of farms carrying out exclusively cash crop production on arable land
[4]PC/GM values on arable land of farms carrying out cash crop and forage production on arable land

Table 4 presents the study's results on the question if our recommendations on climate friendly management reorganisation are cost-efficient and can compete with alternative agricultural mitigation strategies. The table shows the outcome of contrasting agricultural income forgone with emission savings for the most promising mitigation steps as well as the farm-individual span of costs per ton CO_2-equiv. saving.

Across all regions average income forgone per t CO_2 equivalent of landuse-changes targeting "maintenance" ranges between €3 and €158. At this, costs appear not to be excessively high. Even for the reorganization of the most intensive and "highest-prized" landuse-types, such as high intensive grassland and arable land for forage production costs lie within a range between €47 and €158. The reason for the considerably low costs for high-prized landuse-types are the high mitigation potentials accompanying the mitigation steps, which start at a minimum of 12t saving of CO_2-C eq.$ha^{-1}a^{-1}$ for the reorganization of intensive grassland into maintenance in R2 and finish with a maximum of 41t saving for the reorganization of arable land into maintenance in R3. However, the displayed costs/t CO_2 eq. for maintenance measures reflect the "optimal" assumption, that farms are able to either market the harvest product as hay or use it as litter in their own stables. If the farms have to compost the sites' products, income losses per t CO_2-eq. can increase up to 40%.

Income forgone per t CO2-eqivalent of landuse-changes targeting close-to-nature "restoration" tends to be higher than for maintenance and ranges between €8 and €481, even if the mitigation potentials of complete restoration are significantly higher than for maintenance: for restoration of the intensive and dry landuse-types, mitigation potentials vary between 18t (reorganization of intensive grassland into restoration in Region R2) and 44t saving of CO2-C equiv. ha-1a-1 (reorganization of arable land into restoration in Region R3). The higher costs result from the

Table 4. Income forgone of recommended management changes per ton saving of CO2-C equiv. [regional average; (regional, farm-individual minimum to regional, farmindividual maximum)

		R1	R2	R3	R4	R5
Initial use*	Target use	Eur/t CO_2eqivalent				
Arable CC	Maintenance	-	31 (-11 to 38)	0 (-4 to 5)	3 (-5 to 15)	-
Arable FG		124 (95 to 138)	69 (30 to 153)	42 (46 to 35)	102 (51 to 107)	95 (86 to 101)
Arable FG/CC		-	38 (9 to 77)	10 (0 to 29)	36 (30 to 45)	-
GL high int.		53 (30 to 89)	158 (61 to 209)	47 (31 to 92)	67 (39 to 146)	51 (34 to 72)
GL med.. int.		47 (24 to 55)	108 (31 to 161)	32 (4 to 67)	27 (5 to 49)	22 (0 to 42)
GL low int.		24 (13 to 48)	23 (-22 to 114)	15 (-20 to 52)	19 (-17 to 49)	33 (10 to 40)
Arable CC	Restoration	-	40 (15 to 42)	8 (5 to 10)	16 (12 to 24)	-
Arable FG		134 (109 to 145)	68 (4 to 44)	46 (41 to 49)	99 (59 to 100)	98 (89 to 103)
Arable FG/CC		-	45 (2 to 29)	17 (10 to 33)	44 (41 to 49)	-
GL high int.		65 (45 to 97)	126 (5 to 67)	53 (41 to 90)	71 (52 to 128)	55 (40 to 75)
GL med.. Int.		59 (40 to 64)	93 (4 to 47)	39 (17 to 68)	39 (26 to 53)	28 (7 to 47)
GL low int.		42 (35 to 61)	38 (2 to 16)	26 (-2 to 55)	52 (42 to 58)	43 (22 to 49)
Maintenance		481 (383 to 578)	65 (1 to 51)	101 (77 to 124)	83 (66 to 100)	183 (174 to 193)

*Arable CC: Arable land of farms carrying out exclusively cash crop production on arable land; Arable FG: Arable land of farms carrying out exclusively forage production on arable land; Arable FG/CC: Arable land of farms carrying out cash crop and forage production on arable land complete abandonment of agricultural use and the involved loss of CAP's 1st Pillar area payment on the peatland sites. Nevertheless, even for restoration measures, the costs per t CO2 appear comparatively low. This is yet only the case, if restoration can be carried out in a technically optimized way, leading to close-to-nature conditions with watertables averaging at about -10cm below surface. As soon as restoration leads to flooded conditions, mitigation potentials significantly decrease while costs per t CO2-eqivalent increase at about 90%.

To summarise briefly the results of our study, one can say that climate-friendly peatland management, under the assumptions of the usability of the harvest product of maintenance area and an optimal technical implementation of water table enhancement on restoration area, leads to microeconomic (farm-level) costs per t CO2 savings that appear comparable low. As soon as losses of agricultural income can be balanced by high total emission savings, on micro-economic level changes of peatland management can be a cost-efficient strategy to mitigate GHG emissions.

5. Discussion

Our results show that income losses per ton CO2 saving can identify cost-efficient measures of climate-friendly peatland management. However, there are different points to be considered when interpreting our results. By choosing gross margin and processing value to derive agricultural income forgone, we made the clear decision to look at short-term costs. Insofar, the results show site-specific costs which would occur in the concrete moment of an implementation of management changes – for farms which are in a status-quo situation of farm organisation, type of farming and land-use strategy. In contrast to a long-term consideration, possible adaptation strategies (eg. changes in farm organisation or shifts of production to alternative areas) are unconsidered. Furthermore, the use of gross margin and processing value represents "the ceiling" of valuing agricultural area. Agricultural area could also be associated with lower values such as the market price of forage (if it exists) or the regional rent paid for adequate area. However, it should be noted that in the case of extensive management reorganisation forage prices and land rents cannot be considered statically low values. If large-scale management changes should be implemented, the scarcity of rentable land and the increasing demand on the forage market will most likely increase also those values considerably.

With respect to the cost and benefit positions we investigate, it is obvious that they do not cover the variety of positions associated with land-use changes targeting climate protection. Up to now we only consider farmers' income forgone and benefits from emission mitigation. Additional costs and benefits, such as costs of technical implementation and water supply, increases or decreases in biodiversity, macro-economic follow-up costs like damage to buildings or infrastructure or effects on regional development or tourism, are not considered yet.

Another area to draw attention to, are the system boundaries within which our study is conducted. At the moment we calculate farm-individual costs which specifically occur on agricultural sites within a peatland area. By doing so, the effects of management changes which emerge beyond these system boundaries are not considered. Production limitations on peatland sites can cause production-"exports" or an intensification of production on alternative area. Naturally such adaptation measures can also show negative climate effects (eg. intensified fertilisation, enhanced transport, land-use changes for the creation of alternative UAA, etc.). For the derivation of macroeconomic and even global cost-benefit relations of climate-friendly peatland management, profound scenarios involving effects within much broader system-boundaries must be analysed.

Finally, looking at our results, it should be noted that the time courses of emission-reduction measurements are still short; therefore also the derived emission factors have to be treated with caution.

Nevertheless, our results show that regional basic conditions influence the costs of CO_2 mitigation. On the one hand agricultural value added, on the other hand natural mitigation potentials drive the cost-efficiency of management strategies. Our results show that even "expensive" land-use changes can result in comparatively low costs per ton CO_2 equivalent if costs are balanced with high mitigation potentials. Comparing the socio-economic status-quo situation in the single regions, we can estimate where climate friendly peatland management appears to be more cost-efficient or expensive. Particularly in regions where peatland is managed with high intensity, involving high-grade and capital-intensive animal husbandry, management changes are likely to turn out costly. Furthermore, if the share of peatland area is high, farmers' flexibility to adapt is limited and management changes will presumably be refused. In contrast, an implementation of management changes in regions characterised by low-intensive agriculture appears to be more promising. Especially if accompanied by low shares of peatland area and high mitigation potentials, within such regions CO_2 mitigation via adapted peatland management seems reasonable. Generally, (again being aware of the limited system boundaries) compared to alternative techniques, the abatement costs we derived still display an acceptable range. Abatement costs of common agricultural strategies, e.g. biodiesel, plant oils, cellulose-bioethanol, biogas, etc., vary from 20 to 480 €/t$CO_{2\text{ equiv. (WBA, 2007).}}$

Despite this potential competitiveness, as a final note it should be pointed out that in the case of CO_2 reductions, benefits appear to be social whereas costs are private. Farmers have to bear the costs of adaptation and do not directly profit from climate-friendly peatland management. Consequently, in order to successfully implement measures to reduce GHG emissions from peatlands, it is necessary to implement adequate agro-environmental programmes to compensate resulting income losses.

6. Summary and conclusions

Natural peatlands are the only ecosystems which continuously and durably store carbon. Agricultural land use changes the peatlands' function as carbon sinks and leads to high emissions greenhouse gases. In order to lower these greenhouse-gas emissions, a reduction in land-use intensity is necessary. Our study analyses whether this option of GHG mitigation is a cost-efficient measure to be recommended for implementation. We investigate agricultural peatland management in five German peatland areas. To determine cost-efficiency, we carry out farm-individual and plot-specific calculations of agricultural income forgone resulting from promising climate friendly landuse changes. By contrasting income forgone with CO_2 savings, we derive income losses per ton CO_2 equivalent. Our results show that income forgone per t CO_2 equivalent varies due to the regional variability of agricultural structures and natural mitigation potentials. Compared to alternative common abatement strategies, the costs we derive (ranging mainly between 0 and 480 €/t CO_2 equiv.) appear competitive. However, our results are created within narrow system boundaries which do not allow for consideration of further relevant macro-economic cost and benefit positions taken to have a significant influence on abatement costs. In order to fill these gaps, future research is planned. Our study shows that the re-organisation of peatland use could provide fundamental benefits for society. However, in the case of CO_2 reductions, benefits appear to be social whereas costs are private. Against this background, the question arises how either social benefits can be monetarized in order to finance climate-friendly peatland cultivation strategies, or in which way common instruments of agricultural politic can be used to subsidise the farmers' losses.

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RESILIENCE, TO 'BOUNCE WITHOUT BREAKING', IN NEW ZEALAND DAIRY FARM BUSINESSES

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Abstract

New Zealand dairy farmers face an increasingly turbulent business environment which poses risks to their survival. To cope with a turbulent environment, dairy farmers need to have resilient farming systems that have the capacity to better deal with volatility. Although system resilience has been given increasing attention recently, limited research has been undertaken about resilience particularly in relation to New Zealand dairy farmers. The main purpose of this study was to develop an understanding of what resilience means for dairy farming and to determine how it might be measured. In the literature review it was identified that resilience can be described as buffer capacity, adaptability and transformability with increasing degrees of change required with each. The research for this paper focused on buffer capacity, the ability of a farming system to 'bounce without breaking', and carried out rigorous statistical analysis of the DairyBase® database to identify resilience surrogate measures. Of the three attributes of buffer capacity the PCA method identified that the dominant attribute was resistance (both technical and financial efficiency), the less dominant were precariousness (solvency) and latitude (liquidity) attributes. In conclusion, those farms that were more resilient when compared against the less resilient farm businesses, the farms that could 'bounce without breaking' were:

- *technically efficient – produced more milk per cow, hectare and labour unit*
- *financially efficient – generated more profit per unit of revenue, linked costs with prices, had higher Return on Assets*
- *cash liquid – generated more discretionary cash for investment/drawings*
- *managed debt servicing capacity*

The farms that were able to demonstrate both short-term optimization and long-term adaptability (Darnhofer et al, 2008) were those that were neither low input nor high input pasture based farms. They had farming systems that sat in the middle of the range (system 3) so were able to both respond to favourable and unfavourable conditions to improve or protect results respectively; they displayed the flexibility to bounce and not break. Further research is required to identify how some farm businesses are able to maintain resilience throughout quite volatile climatic and economic environments while others cannot. How do these farmers make sense of the information they receive and make sound decisions and what makes their systems more flexible than others?

Keywords: resilience, dairy farm systems, buffer capacity, efficiency

1. Introduction

New Zealand dairy farmers face not only climatic uncertainty but also an increasingly turbulent business environment (Mackle, 2010). Internal and external factors such as increased variability in milk prices, international trade policies, input price variability, policies on bio-fuels, increasing consumer awareness on sustainable food systems, government regulation on animal welfare, environmental regulations and consolidation of the dairy industry have brought about increased variability on the financial performance of the dairy farm business (Boehlje et al., 1995; Boehlje, 2004; Gray et al., 2008; Parsonson-Ensor and Saunders, 2011).

To cope with a turbulent environment, dairy farmers need to build the capacity of their businesses to be able to better deal with periods of poor performance (Kaine et al., 1993) and capture the opportunities that arise to perform better (Detre *et al*, 2006). This essentially refers to developing resilient farming systems. The concept of resilience when applied to agriculture (Milestad & Darnhofer, 2003; Kelly & Bywater, 2005; Crawford et al., 2007; Darnhofer et al, 2010) defines a resilient farming systems as having the ability to buffer and respond to change so resilience is considered a key attribute to help farmers deal with future challenges and shocks (Crawford et al., 2007). As with the ecosystem literature it also identifies resilience as not only persisting and maintaining farming systems through shocks but also adapting and adopting new systems when needed Darnhofer et al. (2010). Broadly speaking, a resilient farm should be able to withstand and/or bounce-back from sudden or acute shocks (such as a spike in input prices, a disease outbreak, etc.). What determines the fate of a business in turbulent market environment is how resilient the business is to turbulence.

The study is part of a wider research project on resilience, entrepreneurship and risk management carried out by the Centre of Excellence in Farm Business Management (www.onefarm.ac.nz), funded by DairyNZ, which is a research and extension organization funded by levies paid by New Zealand dairy farmers.

The overarching aim of this research was to examine the meaning of resilience for New Zealand dairy farmers. Specific objectives include:

- To define resilience for a dairy business farming business in a turbulent environment.
- To explore different measures of resilience in an attempt to identify suitable surrogates (indicators) for measuring resilience among dairy farmers.

Following a comprehensive review of the literature on ecosystems, organizational management and farm management (Rutsito, 2011), a three step quantitative approach was used to determine if resilience can be measured using a sample of dairy farmers from the DairyBase® database. The first step was a comparative analysis of dairy farm systems that determined that all NZ dairy farms were in fact delivering to the low cost of production (CoP) strategy for which they are renowned, some through low input and others high input, the numerator and denominator effect on CoP respectively (Shadbolt, 2012). In particular this step identified the operating profit margin as a key driver of financial success when analysing how systems coped under both high and low price shock scenarios.

The second step began with some in-depth statistical analysis and then grouped the farmers into quartiles with respect to performance and analysed the difference between those farmers that best captured upside risk (when prices lifted from one year to the next) and those that best avoided downside risk (when prices dropped from one year to the next) (Shadbolt, Rutsito, Gray, 2011). Of interest was the finding that none of the farmers who best captured up-side risk were in the group that best minimised down-side risk, this suggested that farms did not readily switch between systems as input and output prices changed. However regardless of the season, a positive or a negative shock, the best results were achieved from those farms that consistently managed their costs in line with their revenue, both groups had higher operating profit margins than their poorer performing counterparts.

The final step, the subject of this paper, was to extend the statistical analysis, this time with 5 years of data (06/07- 10/11) both by year and, where the farmer dataset allowed, across consecutive years, to determine a resilience index for each farm. The dominance of specific indicators in their ability to explain variability between farms and to connect such indicators back as surrogates for measuring resilience was also explored. The KPIs of those farms with higher scores were then compared against lower scoring farm businesses to identify any significant differences.

2. Literature review

The purpose of this section is to integrate knowledge gained from literature (Rutsito 2011; Shadbolt et al. 2011) about the definition of resilience in the context of dairy farming business. The section concludes with the conceptual framework for estimating resilience that was applied in this study. While some farm management scholars have used the term "'sustainability" to define resilience (Conway, 1985; Marten, 1988; Hansen & Jones, 1996; Kaine & Tozer, 2005) the perspective of Ott (2003) is that, instead, resilience is a key factor in achieving strong sustainability. Parsonson-Ensor & Saunders (2011) identify definitions at three levels – operational, ecological-economic and sustainability related – as well as a lack of any distinguished measurable variables for resilience.

The literature identified three key attributes of resilience – buffer capacity, adaptive capacity and transformability. A critical aspect of resilience from the ecosystem, organisational and farm management literature is the *capacity to absorb disturbance,* to *bounce back,* the buffer capacity that allows a system to persist (Conway 1991; Carpenter *et al.*, 2001; Sutcliffe and Vogus 2003; Walker *et al.*, 2004; Folke, 2006; Crawford *et al.*, 2007; Lien *et al.*, 2007; Darnhofer *et al.*, 2008). However, resilience is not merely about a system's robustness, it is also about the opportunities that arise from disturbance (Carpenter *et al.*, 2001; Folke, 2006) and the capacity of an organization to adapt to change (Hamel & Valikangas, 2003; McCann, 2004; Lengnick-Hall & Beck 2005). Darnhofer et al, (2010) describe this as farmers having the strategies to persist and maintain through shocks and adapt and adopt new states when they are needed. This element of resilience, adaptive capacity, is identified as a key element of resilience in farming systems (Crawford *et al.*, 2007; Ingrand *et al.*, 2007; Darnhofer *et al.*, 2008). Adaptive capacity is concerned with major disturbances that are rare, and less expected due to a major change in the underlying environment (Conway, 1993). As with buffer capacity, adaptive capacity can only work up to a point. When the disturbances imposed by highly dynamic environments push a farming system beyond what it can tolerate, transformation becomes the only option (Walker *et al.*, 2004). Transformability has been recognized as a key characteristic of resilient farming systems (Darnhofer *et al.*, 2008) who described it as the ability of a manager to find new ways of arranging resources when conditions make the current systems untenable.

The three attributes of resilience i.e. buffer capacity; adaptive capacity and transformability refer to varying degrees of change (Figure 1). Transformability represents the ultimate level of change. However, different farmers will cope differently with varying levels of change. Their response will vary depending on the level of change, their ability to respond and their perception or understanding of the risk involved.

A key finding of the study of resilience in the three bodies of literature, ecology, organisational management and farm management revealed the paradox between stability and resilience adaptability (Holling, 1996; Kaine & Tozer, 2005; Darnhofer et al, 2008). Stability or engineering resilience (Holling, 1996) focuses on optimization and efficiency whilst resilience adaptability is concerned with persistence of function of a system, which is dependent on its ability to adapt to changes in the environment (Gunderson & Holling, 2001). The resilience framework provides an understanding of the nature of change. This is fundamentally different from the assumption of a system near-equilibrium on which traditional farm management is based which has led to a one-sided emphasis on predictability and stability (Darnhofer *et al.*, 2008; Love *et al.*, 2008). During periods of stability**,** farmers use exploitation-led strategies by optimizing their farming systems and use buffer capacity to cope with variability. However, during periods of disturbance,

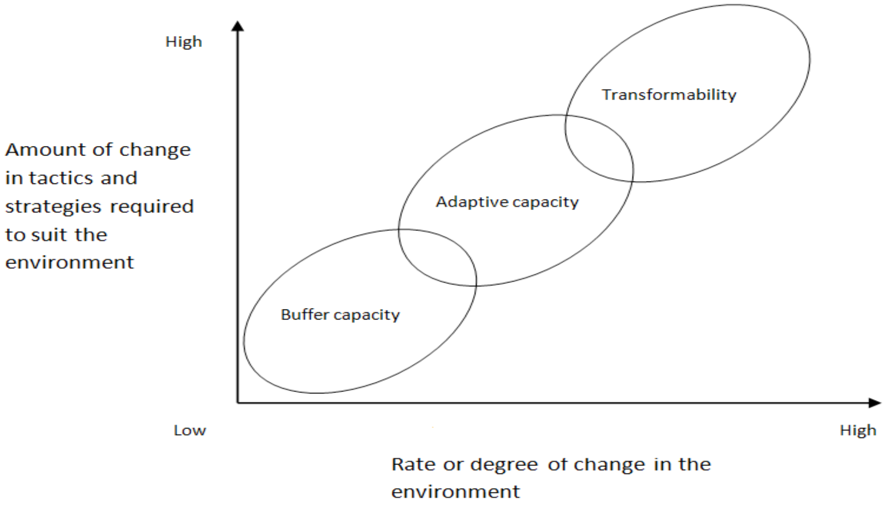

Figure 1. An illustration of the continuum of change, buffer capacity, adaptive capacity and transformability

when both threats and opportunities arise, an adaptive strategy needs to be pursued. To manage a farm for resilience, a portfolio of complementary strategies aimed at achieving both short-term optimization and long-term adaptability would be required (Darnhofer et al, 2008). Kaine & Tozer (2005) describes this as achieving the “*optimum balance between efficiency and resilience in achieving sustainability*’; thus describing the paradox between the two not as antagonistic but rather a fit that must be managed to deliver sustainability.

3. Measurement of buffer capacity resilience

Attempts have been made to measure resilience in ecosystems (Carpenter et al., 2001; Cumming et al., 2005; Carpenter et al., 2005) however, because resilience is not a physical component of the system as such, but an emergent property, its direct measurement is difficult (Fletcher et al., 2006; Crawford *et al.*, 2007; Gray *et al.*, 2008). In view of this limitation, Carpenter *et al.*, (2005) proposed the use of surrogates as a means of indirectly inferring aspects of resilience. They distinguished however between those indicators that measure the current state of the system and resilience indicators that are ‘ever changing variables’ that inform on the capacity of the system to perform as it evolves.

Despite there being few studies into the use of surrogates in measuring resilience, the general farm management literature (Boehlje & Eidman, 1984; Shadbolt& Martin, 2005; Langermeire, 2010) has a variety of other indicators that have traditionally been used to measure the performance of farm businesses, which could be useful in measuring resilience. Parsonson-Ensor & Saunders (2011) propose a range of capital based sustainability indicators including human, natural, cultural and human-made capital with the suggestion that the best gauge of resilience would be ‘non-declining capital stock’ over time. The development of the DairyBase® database in New Zealand (Shadbolt et al, 2007) has provided farmers with both financial and non-financial measures to track their progress and benchmark against other farm businesses. In DairyBase® the business KPIs (Appendix A) identified by a team of experts include productivity, liquidity, profitability and solvency measures but cannot provide measures of human, natural and cultural capital stock. The research methodology required to explore human, natural and cultural capital would involve longitudinal studies of, at the very least, farmer skills and well-being, their networks, common norms and cultural values which would provide useful measures of adaptive capacity and, at the extreme, transformability. That was outside the scope and timeframe of this study in which the focus instead was on buffer capacity using available data relating to human-made capital, the farm, and its physical and financial performance over time.

The Walker *et al.* (2004) model for buffer capacity was adapted for this research. It is characterized by the four attributes of latitude, resistance and precariousness and panarchy. Panarchy, in a farm business, would include the interactions, both formal and informal, and networks that the business has with its supply chain partners and the wider community. The other three attributes focus within the farm system and include latitude, resistance and precariousness (Figure 2). The attributes are mutually exclusive but, ultimately, converge into the resilience status of the system.

Latitude in ecosystems refers to the amount of stretch which a system can allow without losing the ability to return to its original form (Walker et al., 2004). For this analysis of dairy farming businesses the surrogate adopted for latitude is liquidity (Appendix A). A farm with limited cash and sometimes unable to meet its commitments would imply narrow latitude and vulnerability to shocks, and vice versa.

Resistance measures how "resistant" the system is to shocks. For this analysis of dairy farming businesses the surrogate adopted for resistance is *efficiency*, which measures not only the simple input:output technical efficiency of the business but also the intensity with which that business uses its assets to generate gross farm income (Purdy & Langemeire, 1995) and realize profit. This implies that a highly efficient dairy farm would be relatively more resistant (i.e. higher buffer capacity) to shocks compared to a less efficient farm.

Precariousness describes how close the current system is to exceeding the threshold or tipping point and undergoing a permanent restructuring (Walker et al., 2004). Purdy and Langemeire (1995) state that solvency measures provide an indication of the farm's ability to continue operations as a viable business after financial adversity, which typically results in increased debt and reduced net worth. Therefore, for this analysis of dairy farming businesses the *solvency* surrogates were adopted for precariousness.

Based on the above definition of buffer capacity elements it is proposed that while the 3 surrogates of liquidity, efficiency and solvency could be taken as mutually exclusive they ultimately

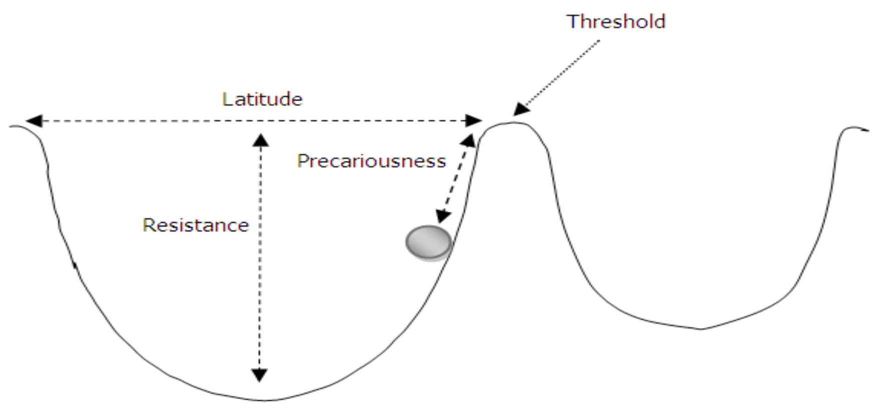

Figure 2. Two dimensional stability landscape based on Walker's model showing three aspects of resilience: Latitude, resistance and precariousness
Source: Walker et al., 2004

converge into an overall resilience status for the farm. In other words one farm business could have buffer capacity by having low debt and maintain a positive cashflow by having low personal drawings yet have poor productivity/profitability while another could have excellent profitability, high debt and a negative to breakeven cashflow position. The latter scenario when coupled with rapidly increasing land values provides the opportunity for significant equity growth and was a common phenomenon in NZ dairy farming in the years up until the financial crisis of 2009. It raised considerable commentary on the sustainability of such a strategy – farming for capital gain (Wills 2009; Ridden 2009; Wallace 2009) particularly as it often led to additional debt.

It is surmised that 2 out of 3 attributes being favourable will deliver buffer capacity but if the farms are 2-3 out of 3 unfavourable they will fail to be resilient.

4. Methodology

One attribute of resilience, buffer capacity, that consists of latitude, resistance and precariousness was measured using quantitative surrogates; liquidity, efficiency and solvency respectively. This began with a statistical principal component analysis (PCA), explained in more detail in Appendix B, of the DairyBase® database, over 5 years (2006/07 – 2010/11) to test the assumption that the underlying 'common information' in the database might be determined by resilience - the underlying common phenomenon being measured. On the basis that this assumption was correct the analysis did then identify and rank farm businesses using those key performance indicators (KPIs) that accounted for the most variability between farms. It identified the KPIs of most relevance in comparative analysis and used them to rank the farm businesses into high:low 'resilience' groups.

The results of the PCA were used to develop constructs to test the data with respect to surrogates for resilience – are these 3 surrogates (latitude – liquidity, resistance – efficiency, precariousness – solvency), essentially groups of KPIs, defined and different from each other? Does one attribute dominate the others and within each attribute do some variables dominate others in terms of variance and commonality amongst the farm businesses that they explain?

In the data set from DairyBase® there are 625 observations in the 2006/07, 628 in the 2007/08, 497 in the 2008/09, 567 in the 2009/10 and 297 in the 2010/11 year. Only 40 farmers have consistent data for each of these 5 years. The PCA analysis identified the KPIs that differentiated the farm businesses most and they were ranked on that basis. The subsequent t-test of all KPIs then determined the measures that were significantly different between the high index farms and the low index farms. This identified other elements of buffer capacity in addition to the dominant elements providing a further test of the resilience of these businesses.

5. Results & discussion

From the PCA analysis it was concluded that the dominant construct, or buffer capacity attribute, is efficiency (resistance) with neither liquidity (latitude) nor solvency (precariousness) dominating in any year[1]. Of interest is the swing between technical and financial efficiency KPIs with financial efficiency dominating overall in the 5 year set of data from 40 farms. The dominant variables of operating profit margin (OPM) and milk production per hectare (kgMS/ha), financial and technical efficiency measures respectively, both meet the definition of surrogates as 'ever

[1] For more in-depth details of the methodology and the results refer to the Resilience of New Zealand Dairy Farm Businesses research report on www.onefarm.ac.nz

changing variables' (Carpenter *et al.*, 2005) able to inform on the capacity of the system to perform as it evolves. It is therefore not always relevant to compare these indicators with previous years (with different climatic and economic environments) but it is very useful to compare them with other businesses within the same year. In essence these indicators reflect the cumulative outcome of decisions made throughout the year and the ability of the business to flex and adapt to within season volatility.

By contrast the indicator operating expenses per hectare was unable to be a consistent surrogate, it flip flopped with the price of milk. When milk prices were low it was negatively correlated with returns and when they were high it had a positive correlation as farmers spent money to capture the higher returns. Similarly the solvency indicator, debt:asset ratio also flip flopped as a resilience surrogate. As described by Shadbolt et al (2011) in step two of this research when farm businesses best captured upside shocks they did it through debt leverage; in contrast those that best mitigated against downside risks had minimal debt leverage.

Further analysis of the group of 40 farms that had data in all of the 5 years (Table 1) identified that the higher index farms achieved statistically better liquidity (discretionary cash per hectare) and better financial efficiency through lower costs per kgMS and per hectare, higher operating profit margin, operating profit/kgMS, return on assets and return on equity than the lower index group.

Table 1. Average performance of two farm groups over 5 years (2006/07-2010/11)

Item	Higher index group (N=19)	Lower index group (N=21)
Latitude (liquidity)		
Discretionary cash/ha	2,018.27	1,074.97
Resistance (financial efficiency)		
FWE/Kg MS	2.94	3.93
Operating expenses/ha	4,131.72	5,096.16
Operating expenses/Kg MS	3.83	4.89
Operating profit (EFS)/Kg MS	2.75	1.60
Operating profit margin (%)	40.21	22.82
Operating return on dairy assets (%)	7.33	3.68
Total Return on Assets (%)	9.76	5.31
Return on Equity (%)	6.32	0.56

In the first two steps of the research it was noted that different farming systems coped better in some circumstances than others but it was not possible to know if individual farms switched from system to system when conditions changed. The outcome of both short-term optimization and long-term adaptability (Darnhofer et al, 2008) can only be measured from a time series of data. How the forty farms adjusted to market and environmental conditions over the 5 years and maintained or lost resilience status was therefore a useful observation (Table 2).

In the two low milk price years of 2006/07 and 2008/09 the more resilient farm businesses were operating the lower input systems 1 to 3 while in the higher milk price years a higher percentage of resilient farms were operating in the higher input systems 3 and 4.

Table 2. Distribution of the 40 farms by farm systems across the 5 years: from system 1 (self-contained low input pasture based system) to system 5 (high input, 30% introduced feed, pasture based system)

Farm and farmer charac-teristics	2006-07		2007-08		2008-09		2009-10		2010-11	
	more resilient (24)	less resilient (16)	more resilient (19)	less resilient (21)	more resilient (27)	less resilient (13)	more resilient (17)	less resilient (23)	more resilient (18)	less resilient (22)
Production system	% frequency									
1	12.50	6.25	0.00	19.05	18.52	7.69	5.88	17.39	5.56	18.18
2	37.50	43.75	21.05	52.38	29.63	15.38	11.76	43.48	11.11	36.36
3	50.00	25.00	47.37	28.57	33.33	53.85	47.06	39.13	44.44	40.91
4	0.00	12.50	21.05	0.00	11.11	23.08	29.41	0.00	38.89	4.55
5	0.00	12.50	10.53	0.00	7.41	0.00	5.88	0.00	0.00	0.00

Also of interest is whether farm businesses were able to maintain their position in the more resilient group (short-term optimizers) over time (long-term adaptability). From Figure 3 it can be seen that 27.5% of the 40 farms maintained their more resilience (MR) status from start to finish, 15% made progress from being low resilience (LR) farms to more resilient while 17.5% remained low resilience farms throughout the five years and 27.5% got worse by starting as more resilient but were classified as low resilience at the end.

Illustrating the breakdown by farming system of the three groups with the most farms (LR:LR:LR, MR:MR:LR; MR:MR:MR) reveals some interesting results (Figure 4). The group that was consistently less resilient appear to follow no particular pattern. The group that was consistently more resilient (MR:MR:MR) however were dominated by system 3 farms (82, 64 and 64% in 06/07, 08/09, 10/11 respectively). The percentage of MR farms in system 4 increased from 0 to 18% in 08/09 and 10/11 so the combination of system 3 & 4 farms was 82% throughout.

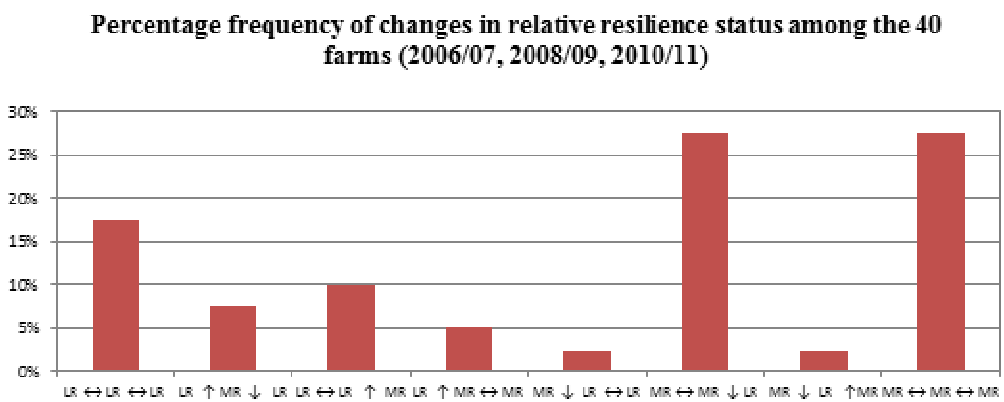

Figure 3. Transition of farm's resilience status between the 3 years of 2006/07, 2008/09 and 2010/11

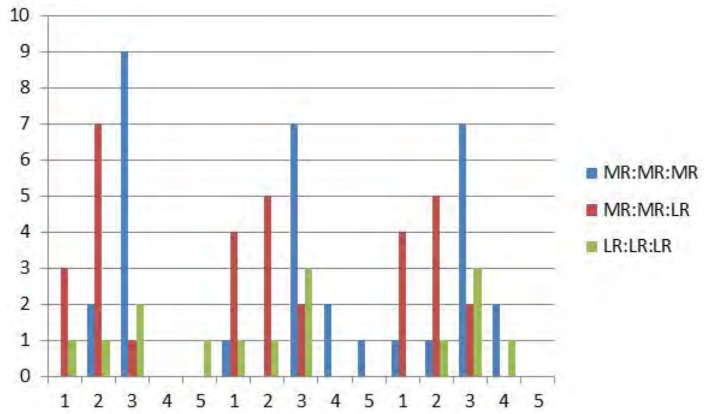

Figure 4. Number of farms in each farming system (1-5) for the three years of 06/07, 08/09 & 10/11 in each of three farms resilience trends (MR:MR:MR; MR:MR:LR; LR:LR:LR)

By contrast the farms that were more resilient in both 06/07 and 08/09 but dropped to less resilient in 10/11 were dominated by system 1 & 2 farms (91, 82 and 82% respectively). These farms are similar to those identified in step two of the research as the farms that managed to mitigate downside risk but were less likely to capture upside risk. The 10/11 year was a high milk price year and these farms were less able to capture the benefits of those higher prices.

6. Conclusions

The PCA enabled the dominance of specific indicators to be determined in their ability to explain variability between farms and to connect such indicators back as surrogates for the attributes of the theoretical model for buffer capacity. The analysis identified and ranked those key performance indicators (KPIs) that accounted for the most variability between farms thereby identifying the KPIs of most relevance in comparative analysis. While the PCA method enabled an index or score to be obtained for each farm the common phenomenon being explored, resilience has three attributes. Of interest is the dominance of the resistance (both technical and financial efficiency) attribute, the less dominant position of the precariousness (solvency) and the latitude (liquidity) attribute. However while solvency and liquidity were weak at differentiating between farms at the highest principal component level they did appear at the lower levels and the subsequent t-test also identified several KPIs in solvency and liquidity for high index farm businesses.

In conclusion, those farms that were more resilient when compared against the less resilient farm businesses, the farms that could ‘bounce without breaking’ were:

- technically efficient – produces more milk per kgMS, hectare and labour unit,
- financially efficient – generated more profit per unit of output, managed expenditure in line with prices (OPM), had higher Return on Assets,
- cash liquid – generates more discretionary cash for investment/drawings,
- managed debt servicing capacity,

with milk production per hectare and operating profit margin the dominant KPIs.

The farms that were able to demonstrate both short-term optimization and long-term adaptability (Darnhofer et al, 2008) and achieved "*optimum balance between efficiency and resilience in achieving sustainability*' (Kaine & Tozer, 2005) were those that were neither low input nor high input pasture based farms. They had farming systems that sat in the middle of the range (system 3) so were able to both respond to favourable and unfavourable conditions to improve and protect results respectively; they displayed the flexibility required to maintain resilience.

Further research is required to identify how some farm businesses are able to maintain resilience throughout quite volatile climatic and economic environments while others cannot. How do these farmers make sense of the information they receive and make sound decisions and what makes their systems more flexible than others? Beyond buffer capacity what is the degree of disturbance farm businesses need to adapt to new systems or to transform into completely new businesses. These questions cannot be answered with quantitative analysis but require in-depth qualitative research to complement the results delivered to date.

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Appendix A. Description of the DairyBase KPIs

KPIs	Description
Resistance (Technical Efficiency)	
Stocking Rate (cows/ha)	Peak Cows Milked divided by Milking area
Kg Milksolids/ha (KgMS/ha)	Milksolids Kilogrammes divided by Milking area
Kg Milksolids/cow (Kg MS/cow)	Milksolids Kg divided by Peak Cows Milked
Cows/FTE	Peak Cows Milked divided by Total Full Time Equivalent labour units (FTEs)
Kg MS/FTE	Total Milksolids Kg produced divided by Total FTEs
Net Cash Income per ha ($/ha)	Net Cash income from milk sales; net (sales-purchases) dairy livestock sales and other dairy farm related revenue. This value is divided by milking area
Latitude (Liquidity)	
Discretionary cash per ($/ha)	This is the cash available from dairy, non-dairy and off-farm operations to meet capital purchases, debt repayments, drawings, and extraordinary expenses (discretionary items). The calculation is Cash Operating Surplus less rent, interest and tax plus net non-dairy cash income, change in income equalisation and net off-farm income. This value is divided by milking area
Cash Surplus/Deficit per ha ($/ha)	The cash surplus from dairy, non-dairy and off-farm operations over the year. The calculation is total discretionary cash plus introduced funds less net capital purchases, net change in debt, drawings and extraordinary expenses. This value is divided by milking area
Drawings per ha ($/ha)	This includes all owners' household cash expenditure eg living expenses, holidays, donations, life insurance and private portion of farm cash expenditure. Any off-farm wages and Salaries earned are netted off drawings. This value is divided by milking area
Precariousness (Solvency)	
Interest and Rent/Total Revenue:	Interest and Rent (excluding run-off rent) paid as a percentage of Total Revenue: Total GFR + Net off-farm income where GFR = net cash income plus value of the change in dairy livestock numbers.
Interest and Rent/Kg MS ($/kgMS)	Interest and Rent (excluding run-off rent) paid divided by Milk solids Kg.
Debt to Assets % (%)	Closing Total Liabilities as a percentage of Closing Total Assets. This measures the proportion of the business value that is borrowed by the owners.
Resistance (Financial Efficiency)	
FWE/Kg MS	Farm Working Expenses divided by Milksolids Kg
Operating expenses per ha ($/ha)	Total Dairy Operating Expenses: (FWE plus depreciation, feed inventory adjustment, value of unpaid family labour, owned run-off adjustment) divided by Milking area.
Operating expenses/Kg MS ($/KgMS)	Total Dairy Operating Expenses divided by Milksolids Kg.
Operating Profit Kg MS ($/KgMS)	Dairy Gross Farm Revenue per Kg MS less Total Dairy Operating Expenses per Kg MS.
Operating profit margin (%)	Dairy Operating Profit (Dairy GFR less Operating Expenses) as a percentage of Dairy GFR.
Asset turnover (%)	Dairy Gross Farm Revenue as a percentage of Opening Dairy Assets.
Operating return on dairy assets (%)	(Dairy Operating Profit plus owned run-off adjustment less rent) as a percentage of Opening Dairy Assets.
Total Return on Assets (%)	(Total Operating Profit plus owned run-off adjustment less rent plus change in capital value) divided by Opening Total Assets. The TRoA is the profit generated by the assets employed plus capital gains or losses. It measures the overall financial performance of the business.
Return on Equity (%)	(Total Operating Profit plus owned run-off adjustment plus net off-farm income less rent less interest) as a percentage of Opening Equity. The RoE measures the return on the funds of the owner but does not include the change in capital value

Appendix B. Analytical approach – Principal Component Analysis (PCA)

PCA is a technique for extracting from a set of observed variables (KJPIs) those few orthogonal linear combinations of the KPIs that capture the common information most successfully. Principal components are uncorrelated and orthogonal (Truxillo, 2003). Meaning a principal component is a linear combination of weighted observed variables (KPIs). PCA is used to measure indirectly from the observed factors a set of few principal factors also called unobservable variables or latent/underlying construct. The latent construct are measured indirectly by determining its influence to responses on measured variables (Harris, 1997). Intuitively the first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information that is common to all of the variables. For instance, as we have a set of KPIs; x_{kj} represents the value of KPIs k for each farmer j. PCA is implemented by normalising each x_{kj} by its mean and standard deviation such that:

$$x_{kj}^{*} = \frac{(x_{kj} - \bar{x}_k)}{s_k} \tag{1}$$

where is the normalised KPIs, and are the mean and standard deviation of KPIs across farmers. The selected KPIs (variables) are expressed as linear combinations of a set of underlying components for each farmer j such that:

$$\begin{aligned} x_{kj}^{*} &= v_{11}A_{1j} + v_{11}A_{2j} + \ldots + v_{1k}A_{kj} \\ &\vdots \qquad\qquad\qquad\qquad\qquad \forall_j = 1, \ldots, j \\ x_{k1j}^{*} &= v_{k1}A_{1j} + v_{k2}A_{2j} + \ldots + v_{kk}A_{kj} \end{aligned} \tag{2}$$

where the *As* are the components and the *v's* are the coefficients on each component for each variable (and do not vary across farmers). The solution for the problem is indeterminate because only the left-hand side of each line is observed. To overcome this indeterminacy, PCA finds the linear combination of the variables with maximum variance, usually the first principal component A_{1j} and then a second linear combination of the variables, orthogonal to the first, with maximal remaining variance, and so on. Technically the procedure solves the equations:

$$v_n(R - \gamma I) = 0 \tag{3}$$

For λ_n and v_n, where R is the matrix correlations between the scaled variables (x's) and $v'n$ is the vector of coefficients on the nth component for each variable. Solving the equation yields the eigenvalues of R, λ_n and their associated eigenvectors, v_n. The final set of estimates is produced by scaling the v_n so the sum of their squares sums to the total variance.

The 'scoring factors' from the model are recovered by inverting the system implied by equation (2), and yield a set of estimates for each of the *k* principal components:

$$\begin{aligned} A_{k1j} &= f_{11}x_{1j} + f_{12}x_{2j} + \cdots + f_{1k}A_{kj} \\ &\vdots \qquad\qquad\qquad\qquad\qquad \forall_j = 1, \ldots, j \\ A_{k1j} &= f_{k1}x_{1j} + f_{k2}x_{2j} + \cdots + f_{kk}A_{kj} \end{aligned} \tag{4}$$

The fist principal component, expressed in terms of the original (un-normalised) variables, is therefore an index for each farmer based on the expression:

$$A_{1j} = f_{11}x_{11}^{*} + f_{12}x_{12}^{*} + \cdots + f_{1k}x_{kk}^{*} \tag{5}$$

The assigned weights are then used to estimate an overall "resilience index" as applying the following formula:

$$R_j = \sum_i^k \frac{[b_i((x_{kj} - \bar{x}_k)]}{s_k} \tag{6}$$

Where R_j is the standardized resilience index for farmer *j; b_i* represents the weights (scores) assigned to the KPIs *k*; other variables as defined above. A negative *Rj* means that relative to the other farmers' measure of resilience, the farmer is not resilient and a positive *Rj* signifies that the farmer is relatively resilient. A zero value, which is also the sample mean index, implies the farm is neither more resilient nor less resilient relative to the farmers sampled.

The critical assumption of the method is that the underling common information is determined by the underlying phenomenon that the index is trying to measure (in this case resilience) which unfortunately cannot be statistically verified since it depends on the correct identification of the relevant variables or indicators, and is therefore largely a matter of judgment. In this study we used physical and financial indicators as surrogates for resilience. The construct of resilience measured here was based on extensive literature as presented above. One of the advantages of PCA apart from being able to estimate objective weights is it estimates the contribution of each variable to the underlying common phenomenon, the construct (in this study, resilience and it's components), and thus enables the ranking of indicators according to their importance in determining a farmer's level of resilience relative to others.

On the basis that the assumption on PCA identified ‘common information’ is correct the analysis could then identify and rank those key performance indicators (KPIs) that account for the most variability between farms thereby identifying the KPIs of most relevance in comparative analysis. While the PCA method enabled an index or score to be obtained for each farm the common phenomenon being explored, resilience has three attributes so also of interest is if all three are expressed in the PCA and whether any one is more dominant.

DETERMINANTS OF INNOVATIVENESS: THE CASE OF SMALLHOLDER RICE FARMERS IN NORTH-EASTERN NIGERIA

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Abstract

This paper sought to identify the determinants of innovative behaviour among rice producers in North-Eastern Nigeria. Cross sectional data was collected from a sample of 270 rice farmers using interview schedule. Descriptive statistics, logistic regression were used as analytical tools. The results revealed that adopters of modern rice production technologies obtained significantly higher yields than the non-adopters' counterpart. Also, significant differences existed in the two adoption status in terms of farmers' income and literacy level. However, no significant differences were found with respect to household size and farming experience between adopters and non-adopters. Furthermore, farm income, access to information, access to credit, literacy level of the decision maker, family size and membership of cooperative societies significantly influenced innovative behaviour of the farmers. It was concluded that knowledge of households' socio-economic and institutional attributes is invaluable when designing and targeting technologies for smallholder farmers. Since revenue from previous years' farming activities, access to extension service, access to credit and membership of cooperative society were found to have played significant role on the innovative behaviour of the farmers, policies that will ensure continued access to credit facilities and effective extension system should be vigorously pursued. This is crucial for increased productivity in rice production in particular and food security in general. Static model to adoption studies using cross sectional data was employed in this research. Further studies could use dynamic models using panel data since adoption decision is a dynamic process involving changes in farmers' perceptions and attitudes as acquisition of better information progresses and farmers' ability and skill improve in applying new methods. This will help in understanding which rice technologies have been adopted and why they are still in use or already abandoned after introduction.

Keywords: agricultural policy, sustainable agriculture, knowledge transfer and extension
Subtheme: transfer of innovations and knowledge

1. Introduction

Nigeria has made substantial investments in agricultural research and extension to increase agricultural production through new technologies. Despite considerable technological change however, agricultural production in this country continued to encounter substantial inefficiencies due to farmers' unfamiliarity with new technology, poor extension and education services, and infrastructure, among others (Shehu, et al., 2007). The slowdown in agricultural productivity growth along with pressures to reform rural research and development (R&D) policy in Nigeria could be said to have escalated interest in finding ways to improve productivity, including through enhancing farmers' innovative capacity. Despite the seemingly simple link, the successful translation of R&D to improved farm productivity depends on many factors. In particular, much relies on farmers' capacity to adopt suitable innovations and successfully integrate them into existing farming systems.

Also, while innovation policy has strongly focused on R&D, less attention could be said to have been paid to improving the capacity of firms to adapt and apply innovations. A broader understanding of innovative capacity and its contribution to farm innovation adoption and productivity growth can also aid in evaluating policies and investment decisions aimed at improving productivity growth.

This study, therefore, was designed to identify some of the factors that influence famers' innovative (adoption) behaviour towards modern rice production technologies in the study area. The salient research questions for which answers were sought in this study include: What are the socio-economic attributes of adopters and non-adopters of modern rice production technologies? What factors that influenced innovative behaviour towards modern rice production technologies?

The broad objective of this study was to examine innovative (adoption) behaviour among rice farmers in North-Eastern Nigeria. The specific objectives were to: compare the socioeconomic attributes of adopters and non-adopters of modern rice production technologies; identify factors that influence the farmers' innovative (adoption) behaviour towards modern rice production technologies in the region; and

Our understanding of the factors that affect the adoption of modern agricultural technology, which this study intend to explore, will provide information that policy makers need to redress the policy failures associated with technology promotion in Nigeria. Static model to adoption studies using cross sectional data was employed in this research. Further research should employ dynamic models using panel data.

2. Literature review

2.1. A framework of innovation at farm level

Farm innovation adoption is the introduction of any new or significantly improved technologies or management practices. These include new products, processes, and organisational or marketing systems that have not previously been used on the farm, although they might not be new to the sector or to the world (OECD 2005).

In agriculture, a useful way to conceptualise the pathways through which R&D contributes to productivity is through an innovation systems framework (Spielman and Birner, 2008; Nossal, 2011). Put simply, R&D is undertaken on and off-farm with the expectation of developing new innovations to be diffused to the farm sector (for example, through extension and social networks) and ultimately adopted by farmers. However, the system is far from linear and there is a complex set of interrelated factors that can shape the innovation process.

Farm innovativeness can be measured by 'innovative effort', that is, the extent to which a farmer adopts a set of innovations. Innovative effort is determined by farmers' capacity and willingness to innovate, and the supply of innovations available to them. Characteristics of a farmer, their farm and their operating environment influence whether they have the capacity to adapt and integrate innovations on their farm, and whether they are willing to do so. Given a supply of appropriate innovations 'on-the-shelf', these farm-level factors determine the likely effort a farm will contribute to innovation.

2.2. Determinants of adoption (innovative) behaviour

Several studies have indicated that the adoption of improved agricultural technologies are affected by many factors such as farm size, age, family size, education, availability of credit, access to information among others (Yishak, 2005; Taha, 2007). Researchers and institutions both within and outside Nigeria have conducted a number of empirical studies on the adoption behaviour of farmers. For ease of clarity the variables often identified as having relationship with adoption of agricultural technologies could be categorized as household personal and demographic variables (e.g., age, farming experience, household size, level of education, gender), economic factors (farm size, farm and non farm income) and institutional factors (extension contact, access to credit, distance from market).

3. Methodology

The study was carried out in North-Eastern Nigeria. Purposive and Multi-stage random sampling techniques were used to select respondents for this study. Cross sectional data was collected from a sample of 285 small scale paddy rice farmers on their household production activities during the 2010/2011 cropping season.

3.1. Analytical techniques

With the aim of achieving the objectives of the study descriptive statistics and binary logistic regression were used as analytical tools.

3.2. The empirical Logit Model

The Logit model was used to achieve objective 4 of the study. The empirical model is specified thus:

$$(Y_i = 1/X_{ij};\ j= 1 \text{ to } 8) = F(Z_i) = 1/1+e^{-zi} = e^z/e^z+1;\ i= 1 \text{ to } 270 \qquad (1)$$

Where: $Z_i = (\alpha, \beta_1 X_1, \beta_2 X_2, \ldots\ldots, \beta_8 X_8, \varepsilon)$,

F(.) = Cumulative logistic function.

Z_i is a theoretical or unobserved or an unobservable variable, that is, although X_i's was generated from the field, the β_i's are not observable. In order to obtain the values of Z_i, the likelihood of observing the sample needs to be formed by introducing a dichotomous response variable Y_i such that:

$$Y_i = \begin{cases} 1 \text{ if the } i^{th} \text{ farmer is adopter of modern rice production technology}^* \\ 0 \text{ if the } i^{th} \text{ farmer is non-adopter of modern rice production technology} \end{cases}$$

X_{ij} is the j^{th} socio-economic and institutional attributes of the i^{th} farmer as contained in Table 1,

β_1 to β_8 are parameters to be estimated,

α = constant term,

ε = disturbance term assumed to have zero mean and constant variance

* measuring innovative behaviour.

3.3. Measuring innovative behaviour

The measure of innovative effort developed for each farm was based on the number and extent of innovations (production recommendations) that each farmer had adopted (during the 2010/2011 cropping season). Given that nearly all the farmers had adopted partially or fully at least one innovation (improved seed varieties, fertilizer, herbicide and/or insecticide), they were grouped into two categories of innovativeness: non-innovators (non-adopters) and innovators (adopters). If a farmer fully adopted three innovations, the farmer is regarded as an innovator (adopter) otherwise s/he is a non-innovator (non-adopter). Based on the foregoing, 100 farmers were classified adopters and 170 as non-adopters. This provides a useful basis for empirical analysis of the underlying factors that might contribute to a farmer's innovative capacity or willingness to innovate (adopt).

Table 1. Description of variables in the logit model

Variable	Variable code	Description and unit	*A priori* expectation
Income	INCOME (X_1)	Revenue from previous harvest farm (Naira)	+
Access to information	INFO (X_2)	Visit by extension worker (number of visit)	+
Access to credit	CREDIT (X_3)	Obtained loan to finance farm work (Yes, 1; No, 0)	+/-
Education	LITERACY (X_4)	Level of formal education attained (years)	+
Farming experience	EXP (X_5)	Duration of time engaged in rice farming (years)	+/-
Farm size	SIZE (X_6)	Total land holding owned by the farmer (hectares)	+
Household size	PEOPLE (X_7)	Individuals in a household (number)	+/-
Membership of cooperative society	CLUB (X_8)	Membership of cooperative society (If affiliated = 1, 0 otherwise,	+

3.4. *A priori* expectations of factors influencing of the adoption of modern rice production technologies

Income derived from the previous year's farming activities indicates the level of profit of the farmers. The expectation is that farmers will have as much capital to plough back into the production process in order to increase profit. Farmers with good returns from their production activities are more likely to be able to afford and apply expensive inputs aimed at increasing productivity; hence, income is expected to influence innovative behaviour positively.

Access to information is a very important determinant of technology adoption because any newly developed technology is introduced to farmers through the activities of extension agents. A farmer whose contact with extension agents is very high is expected to be more familiar and more knowledgeable about the use of improved agricultural technologies. This variable is expected to have positive effect on innovative behaviour.

Access to credit is expected to assist farmers purchase necessary inputs for crop production. Also, it gives farmers additional resources of investment in new ideas and therefore expected to be positively related to their innovativeness. But if the accesses credit is diverted to uses other than farming, the sign could be negative.

Education is very important for the farmers to understand and interpret the agricultural information coming to them from any direction. A better educated farmer can easily understand and interpret the information transferred to them by extension agent. This variable is expected to affect technology adoption positively.

Farming experience could take positive or negative sign depending on the length of period. It is expected to demonstrate increasing returns up to stage and later diminishing return as more elderly farmers have been reported to be more risk averse, hence, are likely to experiment with new technologies.

Household size is an important socioeconomic characteristic because it often determines how much family labour will be put into use on the farm. The variable is expected to have positive influence on efficiency. If however, the adult ratio is low, the sign could be negative.

Cooperative membership popularizes innovation by making farmers exchange ideas, experiences, and makes it cheaper to source information; knowledge and skills in order to enable them improve their livelihoods. The sign of the parameter of this variable is hypothesized to be positive.

Before logit model, multicollinearity was checked to exclude any highly correlated explanatory variables. With this particular study, there is no serious multicollinearity problem. There are various indicators of multicollinearity and no single diagnostic will completely capture collinearity problem. Accordingly, Variance Inflation Factor (VIF) and condition index (CI) were used for continuous variables. If there is larger value of VIF_i, then, multicollinearity is more troublesome. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R^2_i exceeds 0.90), that variable is said to be highly collinear (Gujarati and Porter, 2009). Following Gujarati and Porter (2009), the VIF_j is given as:

$$\text{VIF}\ (X_j) = 1/1 - R^2_j \tag{2}$$

Where, R^2_j is the coefficient of multiple determination when the variable X_j is regressed on the other explanatory variables. There may also be interaction between categorical (dummy) variables, which can lead to the problem of multicollinearity. To detect this problem, Phi (ϕ) coefficients were computed. The Phi (ϕ) coefficient was compounded as follows:

$$\phi = \sqrt{\chi^2} / n \tag{3}$$

Where:
ϕ is Phi (ϕ) coefficient,
χ^2 is chi-square test,
n = total sample size.

If the value of the Phi coefficient is greater than 0.5, the variable is said to be collinear (Gravetter and Wallnau, 2008).

4. Results and discussion

4.1. Descriptive statistics of the socioeconomic and production factors

A summary of the some socioeconomic attributes of the sampled rice farmers is presented in Table 2. The results indicated that there were significant differences in farm income, education and extension contact between the two adoption status of rice producers at 5% level. Furthermore there were no significant differences between adopters and non-adopters in terms of age, household size and farming experience.

Table 2. Summary Statistics of the socio-economic characteristics of the farmers

	Adopters		Non-adopters			
	mean	standard deviation	mean	standard deviation	T-value	p-value
Paddy output (kg)	2633.50	1537.22	1593.94	837.57	2.59*	0.0000
Income (₦)	17025.61	10451.61	4960.27	5899.77	12.13*	0.0000
Household size (number)	7.65	6.17	14.41	8.36	-7.03	1.0000
Education (years)	7.50	5.59	3.77	4.85	5.76*	0.0000
Extension contact (number)	7.61	2.51	2.35	2.29	17.57*	0.0000
Farming experience (years)	12.6	6.31	12.03	5.86	0.90	0.1838
Total number of observation	100		170			

*Significant at 5 % level, (degree of freedom = 268)

Source: Field survey, 2011

4.2. Determinants of innovativeness towards modern rice production technologies

Explanatory variables that were selected for econometric model were discussed based upon the model output. Accordingly, as indicated in Table 3, about 96 % of the total variation for the modern rice production technique is explained by logistic model. The $\chi2$ result which is significant ($P < 0.001$) shows that the model fits the data. The model correctly predicted sample size of 95 % and 96.5% for adopters and non-adopters, respectively.

All the variables included in the model had the hypothesized signs. The decision by households to adopt modern rice technologies significantly is influenced by income ($p < 0.001$), access to information ($p < 0.001$), access to credit ($p < 0.001$), level of education of the household head ($p < 0.05$), household size ($p < 0.05$) and membership of cooperative society ($p < 0.01$).

Table 3. Logit equation of factors influencing the adoption of modern rice production technologies of farmers

Variables	Coefficients (B)	Standard error	Wald	Significance	Exp (B)
Constant	-3.704	1.673	4.902	0.027*	0.025
INCOME	0.0003	0.000	20.334	0.000**	2.522
INFO	0.816	0.171	22.778	0.000**	2.261
CREDIT	-3.885	0.877	19.636	0.000**	0.021
LITERACY	0.181	0.079	5.211	0.022*	1.199
EXP	-0.009	0.055	0.024	0.878	0.992
SIZE	0.141	0.744	0.036	0.849	1.152
PEOPLE	-0.253	0.112	5.108	0.024*	0.776
CLUB	2.191	0.849	6.656	0.010**	1.112
Number of farmers	270				

**Significant at 1%, ** Significant at 5%

-2 log likelihood 61.548

Chi-square (χ^2) 294.359***

Predicted Adopter 95%

Non-adopter 96.5%

Overall 95.9%

Source: Field survey 2011

The odds ratio [Exp(B)] for this variable was 2.261 (Table 3), which suggest that farmers who had more contact with extension agents are more than two times likely to adopt modern rice technologies than those with no access to extension agents.

Income derived from the farming activities indicates the level of profit of the farmers. The expectation is that farmers will have as much capital to plough back into the production process in order to increase profit. The results in Table 3 indicate that income was positive and significant ($P < 0.001$). The implication of this finding is that farmers with good returns from their production activities are more likely to be able to afford and apply expensive inputs aimed at increasing productivity.

The results in Table 3 revealed that access to information defined by number of visits by the extension agents to farmers significantly ($P < 0.001$) affects adoption of modern rice production technologies. The positive and significant coefficient of access to information could be attributed mainly to the fact that knowledge gained from the contacts with extension agents by the farmers' influence them to adopt new technologies. This is in consonance with the findings of Tiamiyu *et al.* (2009) who reported a positive relationship between extension visits and technology adoption among growers of New Rice for Africa (NERICA) in savanna zone of Nigeria.

The coefficient of access to credit had the hypothesized positive sign and significant ($P < 0.001$). The significance of the variable stemmed from the fact that agricultural credit is a basic tool of production which provides farmers with additional source of investment in modern production technologies. The more access farmers have to credit facilities the higher the likelihood that they may adopt modern technologies recommended to them. The positive effect of the variable on adoption is a reflection of ability to purchase productive inputs for farming activities. This concurred with studies by Foti *et al*. (2008) who reported a positive relationship between farm size (taken as a surrogate for wealth and access to credit) and the adoption of selected soil fertility and water management technologies in semi-arid Zimbabwe.

Literacy level had a positive coefficient and significant at 5% level. This conformed to *a priori* expectation. This is in consonance with the findings of Lawal *et al.* (2004) who reported positive and significant relationship between education and adoption of improved maize varieties among smallholder farmers in southwestern Nigeria. This shows that being literate farmers easily understand and analyze the situation better than illiterate farmers. Another explanation could be, the more years of formal schooling farmers had, the better enlightened they become and subsequently the easier it becomes for them to better understand and adopt production recommendations.

As shown in Table 3, the coefficient of family size, which is defined by the number of people in a household had negative coefficient and statistically significant at 5% level. The negative coefficient of family size could be as a result of low adult ratio in the sampled households. The significance of the variable could be explained by the fact that labour is an important input in rice production.

Membership of cooperative society had positive and significant ($p < 0.05$) influence on adoption behaviour of the sampled farmers. The result is in agreement with that reported by Mihiretu (2008). Adoption of modern rice technologies could be motivated by belonging to a cooperative society. Cooperative membership popularizes innovation by making farmers exchange ideas, experiences; and makes it cheaper to source information, knowledge, and skills in order to enable them improve their livelihoods.

5. Conclusions

It was concluded that knowledge of households' socio-economic and institutional attributes is invaluable when designing and targeting technologies for smallholder farmers. Therefore, efforts geared towards ensuring that loans and other credit facilities are made available to the smallholder farmers at minimum interest rates. Also, there is need for the revitalization and priority funding of the extension delivery activities of the States' Agricultural Development programmes (ADPs). This is crucial for increased rice production in the country.

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THE DIFFERENCES IN COST EFFICIENCY OF DAIRY FARMS IN FOUR REGIONS OF POLAND

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Abstract

The cost efficiency of the dairy subsector has been analyzed using data for four FADN regions in Poland for the period 2004/05-2007/08. The cost inefficiency indexes have been calculated for each farm from each region. Overall, all applied measures have been statistically significant in the heteroskedasticity consistent estimation except for the farmer's age. Regional differences have been pronounced and the benchmark Mazowsze and Podlaskie region showing higher cost efficiency than two other major regions, but not a minor, in terms of dairy production, Małopolska and Pogórze region. It is likely that the regional specialization will continue with the benchmark region gaining further advantage. A sub-regional analysis has been recommended for the future study.

Keywords: FADN data, cost frontier function, fixed effects, inefficiency, cost efficiency index

1. Introduction

The discussion surrounding Polish agriculture in the 1990s centered on the large size of the sector in terms of employment, yet its relatively limited contribution to the GDP. The number of employed in agriculture is subject to debate and affected by the changing methodology of estimating agricultural employment (GUS, p. 181, 2007; GUS, pp 46-47, 2011). Numerous experts lamented low productivity and compared the state of the agricultural sector in Poland disfavorably to that in other countries in the 1990s. But the sector has been undergoing rapid changes due to new, accessible technology embodied in equipment and biological inputs.

The discussion about employment subsided because of rapid modernization in Polish agriculture. Modernization advances faster in specialized farms and among the specialized farms, dairy farms have probably changed most. Dairy farms increased their efficiency by adopting new farm organization practices, modern technology, improved cow productivity, and improved milk quality. Their growing average size offers permanent job opportunities to hired labor because the seasonality of milk production is less pronounced than in the past. However, commercial dairy production has been increasingly concentrated in selected regions because the cost competitiveness eliminates many small producers, especially in areas with unfavorable natural conditions for dairy production or lacking processing infrastructure. In recent years, there has been a notable concentration of processing capacity as the dairy processing cooperative sector undergoes cost-induced re-structuring.

The objective of this paper is to examine the cost efficiency of dairy farms, while accounting for possible regional differences. Regional differences implicitly indicate the ability of dairy farms to create additional jobs in rural areas, which suffer from a higher unemployment rate than the towns and cities in Poland. The increasing concentration of land and mechanization of production reduces the need for human labor. The rural population is less dependent on agriculture for jobs, but non-farm jobs are limited, especially in certain areas (Klepacka, 2012). Several regions of Poland experience depopulation and a major contributing factor is outmigration. Migration has intensified after Poland's accession to the European Union (EU) in 2004 and the opening of labor markets in many of the older EU member-countries. As a result, the local labor availability changes because the young, skilled laborers can find better paying jobs abroad. Increasingly concentrated and efficient agricultural production is not likely to stem the outflow of people, but the regional differences in the type of production allow higher employment levels than others. Therefore, the focus of the paper is on dairy farms, which typically use more labor than farms specialized in other livestock or plant production.

The Polish farm sector situation was not a priority of national economic policy, except in the early 1990s when the government abolished the state farm sector and transferred the operation of former state farms to individuals or companies through sales or lease agreements. The effect was a rapid reduction of government subsidies to maintain and operate the inefficient farms. The result was a dramatic decline in livestock production reflected in the decline in animal herds. The average number of cows in Poland between 1996 and 2000 was 340,200 and has been declining, reaching 279,500 in 2005 and 265,000 in 2010. The decline in livestock numbers was followed by a decline in employment, although the figures are blurred by the changes in the methodology of calculating farm employment.

The adjustments were substantial in the dairy sector, which enjoyed a privileged position under the centrally planned economy. Dairy products including butter were given a high priority because of the high demand resulting to some extent from the administered pricing mechanism. Once prices were allowed to adjust to market supply and demand conditions, the shortages experienced for decades disappeared. In spite of declining cow numbers and farm sector size, consumers did not experience shortages of dairy products or food in general. The private farm sector responded to market prices and changed economic conditions by undergoing re-structuring and eliminating the inefficient producers. The elimination was limited to the withdrawal from milk production, and less so from agricultural production overall, as job opportunities were scarce for rural labor. The economic policy treated agriculture as the "holding tank" for surplus labor, accepting the underemployment rather than accelerating the replacement of labor by capital in agriculture.

The cost pressure has been forcing dairy farms to continually adopt cost-cutting measures. In the dairy sector, the production scale has been steadily increasing and encouraged growth in areas with suitable natural conditions. Such conditions are particularly suitable in the northeastern regions of Poland, in parts of Mazowieckie Voivodship and Podlaskie Voivodship. The soil type and quality better fits dairy production than commercial field crop production. The location of Warsaw, the largest city in Poland, also represents a major market for dairy products. An area that remained competitive in dairy production was Wielkopolskie Voivodship, especially some of its areas located in the river valleys to the south and north of Poznan, the regional capital. The dairy sector fully recovered from the early 1990s downturn, but the increased efficiency forced many small herds out of commercial production and continues to encourage the expansion of herds as well as per cow milk production. Some studies that applied national-level analysis found the productivity of Polish dairy farms surprisingly high (Barnes, Revoredo-Giha, and Sauer, 2011).

2. Cost frontier estimation approach

A stochastic cost frontier using a panel data fixed effects model was used in the estimation (i.e., the within estimator (Hsiao, 1993)). This considers inefficiency as a time invariant (Schmidt and Sickles, 1984; Kumbakhar and Knox Lovell, 2003; Greene, 2005). In addition, in order to test the presence of possible technical change, we included a quadratic trend in the cost equation. The trend variable took the value of one in 1995, two in 1996, and so forth.

The fixed effects stochastic cost frontier model can be written in the following way (Kumbakhar and Knox Lovell, 2003), where i denotes farms and t the periods:

$$\ln E_{it} = \ln C(Q_{it}, W_{it}, \tau_t; \Omega) + v_{it} + u_i \tag{1}$$

In equation (1), $\ln E_{it}$ is the logarithm of the observed expenditure and $\ln C(Q_{it}, W_{it}; \Omega)$ is the logarithm of the deterministic cost function that depends on the outputs Q_{it}, the input prices W_{it}, a deterministic trend τ_t to capture technological change, and a vector of parameters Ω. The statistical error is represented by v_{it}, which is assumed to be independent and identically distributed with mean zero and variance σ_v^2. The time invariant inefficiency term u_i is positive.

The estimation of the stochastic cost frontier (i.e., $\ln C(Q_{it}, W_{it}, \tau_t; \Omega) + v_i$ and the inefficiency terms (i.e., u_i) requires the choice of a functional form for the deterministic part of the stochastic cost frontier (i.e., $\ln C(Q_{it}, W_{it}, \tau_t; \Omega)$. A generalized multiproduct translog cost function (Caves, Christensen, and Tretheway, 1980) was selected because it imposes fewer a-priori restrictions than other functional forms commonly used for the task. As explained by Caves, Christensen, and Tretheway in the context of multiproduct estimation, some outputs might not be present on a farm, and therefore the logarithm used in the translog function will produce an error. Instead, they propose the use of a Box-Cox transformation to substitute for the logarithm of the output terms. It should be noted that the Box Cox transformation is only one of the possibilities. Instead, in this paper we use f(Q) = Q, which provides a hybrid between the translog function and the quadratic function. Thus, for the case of n inputs and m outputs, the cost function is given by:

$$\begin{aligned}\ln C(Q_{it}, W_{it}; \Omega) &= \alpha_0 + \varphi_0 \tau_t + \varphi_0 \tau_t^2 + \sum_{j=1}^{n} \alpha_j \ln W_{jt} + \tfrac{1}{2}\sum_{j=1}^{n}\sum_{k=1}^{n} \beta_{jk} \ln W_{jt} \ln W_{kt} \\ &+ \tfrac{1}{2}\sum_{j=1}^{m}\sum_{k=1}^{n} \delta_{jk} f(Q_{jit}) \ln W_{kt} + \sum_{j=1}^{m} \gamma_j f(Q_{jit}) + \tfrac{1}{2}\sum_{j=1}^{m}\sum_{k=1}^{m} \rho_{jk} f(Q_{jit}) \cdot f(Q_{kit})\end{aligned} \tag{2}$$

As the stochastic cost frontier is a cost function, it has to satisfy the properties of any cost function (Chambers, 1988). Price homogeneity and symmetry were directly imposed in (2) through the following restrictions to the parameters (3):

$$\sum_{j=1}^{n} \alpha_j = 1;\ \sum_{j=1}^{n} \delta_{jk} = 0;\ \sum_{j=1}^{n} \beta_{jk} = 0;\ \sum_{k=1}^{n} \beta_{jk} = 0;\ \sum_{j=1}^{n}\sum_{k=1}^{n} \beta_{jk} = 0; \beta_{jk} = \beta_{kj} \tag{3}$$

As previously noted, the dataset does not contain input prices for each farm. In the context of cross section estimation, the approach is to assume that all farmers face the same prices (e.g., Alvarez and Arias, 2003). However, for estimating a cost function using panel data it is possible to introduce prices, assuming that all the farmers face the same input prices within a year (i.e., across farms), but that prices change over time.[1] A common problem in the estimation of produc-

1 In a different context, similar assumptions can be found in the estimation of demand systems, where price elasticities are sometime estimated from time series because of the lack of variability of prices in cross section datasets (Hsiao, 1993, p.206).

tion stochastic frontiers is that the use of a fixed effect model precludes the use of time invariant variables. However, in the context of cost function estimation, this can be overcome due to the fact that the parameters associated with input prices can be estimated from the cost share equations, where the inefficiency term (i.e., the fixed effect terms) do not appear. Then, the equation to be estimated is presented in (4), where the intercept in (4) is $\alpha_{0i} = \alpha_0 + u_i$.

$$\ln E_{it} = \alpha_{0i} + \varphi_0 \tau_t + \varphi_0 \tau_t^2 + \sum_{j=1}^{n} \alpha_j \ln W_j + \tfrac{1}{2} \sum_{j=1}^{n} \sum_{k=1}^{n} \beta_{jk} \ln W_j \ln W_k$$
$$+ \tfrac{1}{2} \sum_{j=1}^{m} \sum_{k=1}^{n} \delta_{jk} f(Q_{jit}) \ln W_k + \sum_{j=1}^{m} \gamma_j f(Q_{jit}) + \tfrac{1}{2} \sum_{j=1}^{m} \sum_{k=1}^{m} \rho_{jk} f(Q_{jit}) \cdot f(Q_{kit}) + v_{it} \quad (4)$$

Equation (4) was estimated for five inputs (i.e., n) and three outputs (i.e., m). Given the high number of parameters to be estimated, the following econometric procedure was employed. First, the system of (n – 1) cost shares was computed, using Iterative Seemingly Unrelated Regression Equations (ISURE) and imposing the constraints in (3). This step provided the values for all the terms in (4) that were associated to input prices. Second, all the remaining parameters of the cost function, except the fixed effect terms (i.e., output terms not associated with prices) were estimated using the within estimator (ordinary least square applied to the variables expressed as deviations of the means by farm as in Hsiao, 1993). Finally, the fixed effect terms used in the construction of the relative cost efficiency indices were estimated from equation (4) by evaluating the function at the mean value of the variables by farm (Atkinson and Cornwell, 1993; Kumbakhar and Knox Lovell, 2003; Pierani and Rizzi, 2003)[2].

As shown in Kumbhakar and Knox Lovell (2003), the relative cost efficiency index (CEI_i) for a sample size N was computed as equation (5) based on the estimated fixed effect intercepts (i.e., $\hat{\alpha}_{0i}$), where for the most cost efficient producers it has a value equal to one:

$$CEI_i = \exp\{-(\hat{\alpha}_{0i} - \min_i\{\hat{\alpha}_{0i}\})\} \quad i = 1,..., N. \quad (5)$$

The results of the cost function estimations are presented in Table 1.

Table 1. Estimation Results of Dairy Farm Cost Efficiency, Poland, 2004/05-2007/08

Variable name	OLS	
	Estimated coefficient	Std. error[a]
Intercept	0.1227	0.3668
Total debt to asset ratio	0.3078**	0.1124
Long-term debt to total debt ratio	0.3189**	0.0407
Farmer’s year of birth	0.0012	0.0020
Total labor to unpaid labor ratio	-0.9808*	0.2483
Total subsidies to output	-1.6742**	0.1325
Pomorze and Mazury	0.0922**	0.0255
Wielkopolska and Śląsk	0.1712**	0.0211
Małopolska and Pogórze	-0.1196**	0.0298
Number of observations	2245	
R-square	0.3528	

[a] Standard errors are heteroscedasticity consistent; Note: *, ** denote significant at 5% and 1% levels, respectively.

2 The farm level estimated fixed effects used to compute the relative cost efficiency indices were assumed to be constant over time due to the short period covered by the sample (in the best case, information was available for some farms for eight years) (Kumbakhar and Knox Lovell, 2003, p. 170).

3. Data

Data used in this paper is from the Farm Accounts Data Network (FADN) database. The FADN annually records a wide range of financial and non-financial data for a selection of full-time farms across the EU. The data used were available only since 2004/05. This resulted in an unbalanced panel dataset.

Costs and outputs by farm type were computed directly from the FADN data. Costs were allocated to one of five groups: materials (e.g., feed, fertilizer); energy; labor (i.e., all labor used including that of the farmer, farm family, business partners, and hired workers); land (owned and rented) and capital (e.g., rent, depreciation). The three outputs were considered: crops, livestock, and other outputs, all of them in real terms.

The estimation of cost functions requires input prices. However, a shortcoming of the FADN data for the estimation of cost functions is that it only presents input expenditures and not the prices paid for inputs (or quantities used). Therefore, Eurostat's input price indices data (base year 2004) were used for agricultural materials, energy, and capital as an estimate of those prices paid by farmers over the study period. The labor and land input prices were estimated from the FADN data.

Poland has created a panel of farms including dairy farms. The panel may not be fully reflective of Poland's dairy sector. It is likely that farms with a single cow or very small herds are under-represented. However, the interest of the authors is the competitiveness of producers and their ability to create jobs in rural areas, and not in self-supply of milk, which is the primary reason for keeping a single animal.

The data are annual observations for the period 2004/05-2007/08. The unbalanced panel included 2,245 farms, but a total of 4,755 observations is used in this study. Farms were located in a number of administrative regions, which were grouped by the national reporting agency in four large regions including the Mazowieckie-Podlaskie (1,364 farms), Pomorze-Mazury (341 farms), Małopolska-Podgórze (159 farms), and Wielkopolsks-Śląsk (382). The reported farm data included all standard information in the FADN data base.

4. Estimation results

Overall, the explanatory power of the used set of data has been confirmed by the F-test results and the adjusted R-square value is 0.3528. With one exception, all explanatory variables are statistically significantly influencing the depended variable, which is the fixed cost coefficient. Two measures of debt lead to an increase in the costs of production. The elasticities are of similar size and the effect of long-term debt has a slightly higher effect. Dairy farms had to heavily invest, enlarge herds, and expand production to stay competitive and the effects of that approach are confirmed by the results. The shrinking of the cow herd in the early 1990s was the reflection of cost adjustment after decades of responding to administrative pressures to engage and increase milk production to satisfy the demand stimulated by unrealistic retail prices and a limited availability of consumer goods in general.

The effect of gross investment to total output also leads to cost increases, but the effect is rather small. In the case of a dairy farm, the output effects may not occur in the year investment takes place because of the nature of the production. Typically, the output will increase but over time, especially if the investment leads to adding animals or increasing cow productivity.

The three regional dummies indicate that cost efficiency in the regions differs from the benchmark region of Mazowsze-Podlaskie. Mazowsze-Podlaskie is the area where a number of very large dairy processing companies are located and where the natural conditions are particularly suitable for dairy production. Large areas of meadows and pasture are located north and northeast of Warsaw, the capital of Mazowsze. The region has witnessed a major expansion of dairying in the area in the last two decades. Because the soil quality tends to be lower than in other parts of the country, dairy farms could convert some arable land to pasture. The signs of the dummy regional indicators suggest that two regions to the west and northwest of the benchmark region are characterized by higher costs. The particular aggregation of regional data applied in the Polish FADN may, in part, contribute to the result. The combination of Wielkopolska and Śląsk into a single area may obscure the efficiency of Wielkopolska dairy farms. Historically, the region has been known for the highest farm management level, while many farmers in Śląsk have less experience. Results also indicate that the southeastern areas of Małopolska and Pogórze have been more cost efficient. This result is interesting, but not likely to change the commercial face of the Polish dairy sector. First, the number of dairy farms in that region is small. Second, the topography and the amount of agricultural land is inadequate for the expansion of many farms. Other factors that limit potential expansion are milk processing capacity constraints and the fragmented land ownership, which could be costly in case of any attempt to expand production.

5. Implications

The potential practical consequences of the cost efficiency differences across regions are illustrated in Figures 1 through 4. The benchmark region distribution of farms (Figure 1) shows a fairly tight distribution and indicates that there are some farms that are relatively high-cost producers. These farms will likely cease to produce milk and possibly their land will be consolidated into larger farms. The illustration is particularly realistic because of the large number of farms in that region, which justified selecting it as the benchmark as well. But interestingly, there are more cost-efficient farms in the region shown in Figure 3 if one considers the relative share of farms at each cost efficiency level. As mentioned above, Wielkopolska and Śląsk were combined into a single FADN area, while being very different in nature and the strength of their agriculture. That artificial combination can be seen in Figure 3, where the distribution resembles that of combining two different distributions, one with lesser cost efficiency. The result suggests the need for further disaggregation of the analysis to the level of sub-region. The cost-efficient region of Małopolska and Pogórze shows many diversified levels of efficiency (Figure 4). Moreover, the number of farms is considerably smaller than in the case of other regions suggesting that although the farm may be efficient, they are too few in number and have a very localized effect.

The regional differences in cost of living, which have not been explicitly accounted for in this study, suggest that the benchmark region will continue to improve its competitive position against other regions except of Małopolska and Pogórze, but the latter is unlikely to witness dairy farming expansion (at least not in terms of cow milk production). The full effect of cost of living differences cannot be considered given the aggregation into four regions because the relatively low labor cost area of Podlaskie is combined with the highest labor cost area of Mazowsze, whereas the effect of high labor costs in Warsaw distort the discrepancy between outlying rural areas and the city.

Similarly, the unemployment rate, especially rural unemployment, varies greatly within the benchmark area and across regions. The relatively high unemployment and lower than national

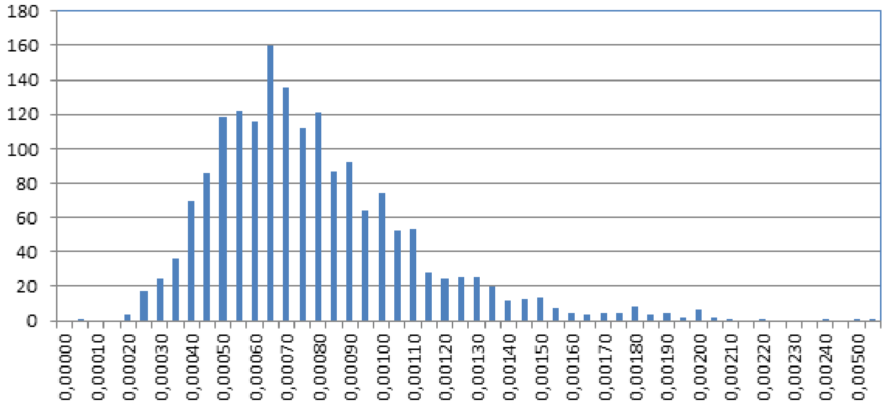

Figure 1. The distribution of dairy farms in terms of cost efficiency in Podlasie and Mazowsze FADN area, Poland
Source: Authors' calculations based on estimation results using the FADN data

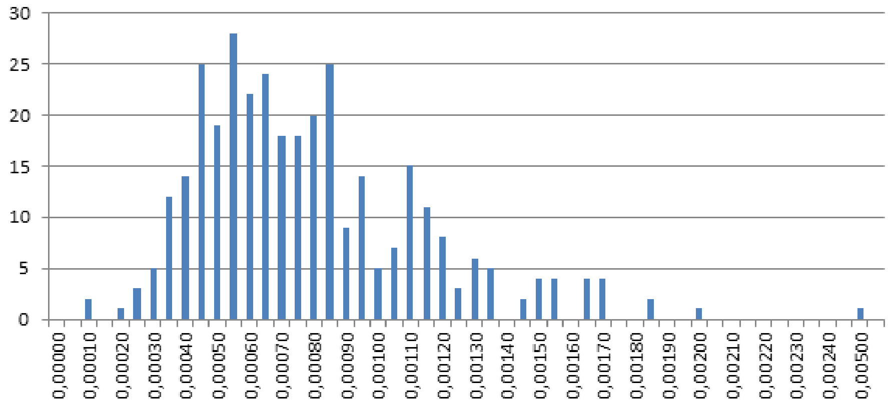

Figure 2. The distribution of dairy farms in terms of cost efficiency in Pomorze and Mazury FADN area, Poland
Source: Authors' calculations based on estimation results using the FADN data

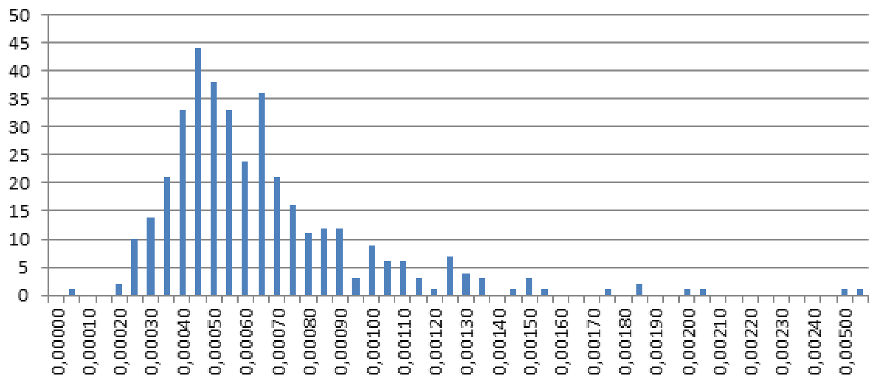

Figure 3. The distribution of dairy farms in terms of cost efficiency in Wielkopolska and Śląsk FADN area, Poland
Source: Authors' calculations based on estimation results using the FADN data

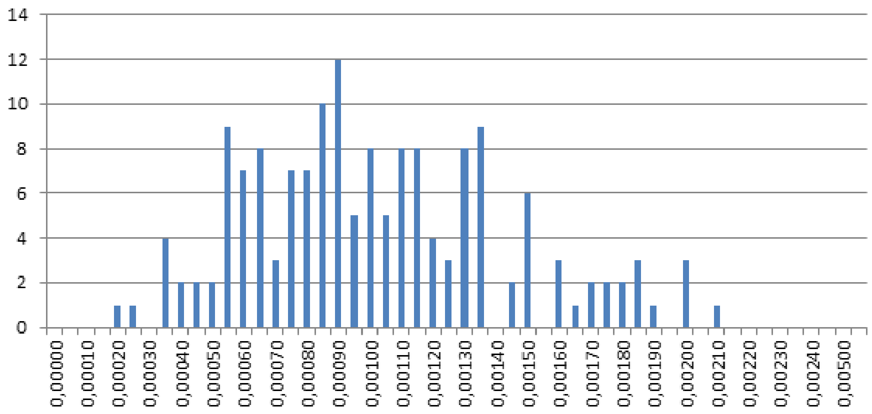

Figure 4. The distribution of dairy farms in terms of cost efficiency in Małopolska and Pogórze FADN area, Poland
Source: Authors' calculations based on estimation results using the FADN data

average incomes, contribute to the migration in search of better economic opportunities. Podlaskie is one of the regions which has experienced outmigration for a long time and the accession to the European Union farther contributed to this phenomenon. Dairy farms utilize more labor than field crop farms and the continuing development of that subsector of agriculture could offer, however limited, job opportunities. Estimation results suggest that those utilizing primarily their own labor were more cost efficient, but enlargement of herds eventually will require hired labor to improve economic returns. The speed with which the changes will take place is expected to accelerate in the dairy industry after April 1, 2013, when milk quotas will be abolished. Nevertheless, the noticeable effect on employment will likely be quite small.

6. Concluding comments

Farmers in Poland gained access to investment funds under the EU *Common Agricultural Policy* programs, which also permitted expansion of production. Investment funds have been particularly useful for livestock operations including dairy. Dairy farm production expansion could benefit from additional labor. Between 2009 and 2010, the employment in agriculture increased by about 2,400 jobs (GUS, 2011), but the data do not provide details about the farm type or geographical area where the new jobs were added. However, the general trend of an increase in agricultural employment is consistent with both the demographic changes and reversal of migration due to the shrinking job market in other EU countries. The full demonstration of the financial crisis in 2008 and the subsequent economic slowdown in many EU countries led to a decrease in demand for labor. Lower labor demand and the lack of prospects for a speedy recovery caused many job-seeking migrants from Poland to return home. The reverse migration increased the supply of labor, including the labor in rural areas and areas where outmigration was largest.

Within Poland, regional competitiveness is affected by other factors as well and labor costs could shift jobs across regions. The northeastern areas may strengthen the competitive position of their dairy sector due to natural resource endowment and less expensive labor. Such tendencies will further delineate the specialization and limit the farm types found in individual regions. To obtain a fuller picture of cost efficiencies in dairy production, a sub-regional analysis is warranted.

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PERFORMANCE AND MARKETING OPTIONS FOR RED MEAT IN THE FORMAL AND INFORMAL VALUE CHAINS IN THE FREE STATE PROVINCE

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Abstract

Marketing of agricultural products and market access has been a well researched topic during recent years. More so in the South African agricultural sector due to the dualistic nature of the South African agricultural sector and the economy in general. There is a distinct difference in the formal and informal agricultural sectors with both facing a number of challenges; there are a number of challenges facing the informal sector specifically related to market access. The aim of this paper is to compare the performance of the formal and informal sectors and to identify the different marketing channels utilised by these sectors, as well as the challenges in the informal sector related to market access.

Primary information was gathered by means of structured questionnaires in both the formal and informal red meat sub-sectors in the Free State province of South Africa. Analysis showed that the performance of the informal sector, measured as calving rate and off-take rate is well below that of the formal sector. Although various well established marketing channels exist in the province, producers in the informal sector rarely make use of these channels mainly due to low levels of production and inadequate quality; this is mainly due to lacking herd management and breeding practices brought about by insufficient infrastructure within the informal or communal production systems.

This paper concludes that there is still ample scope to increase red meat production within the informal sector by improving calving- and off-take rates. By increasing the calving rate by 35%; beef production could be increased by 325%. South Africa can make a positive contribution towards global red meat production given the predicted increases in global food demand. The main constraints that should be addressed through policy intervention is the availability of basic infrastructure requirements necessary for proper herd management and breeding practices as well as access to credit; which is limited in the informal sector due to the lack of land ownership and subsequently security.

Keywords: marketing channels, performance, calving rate, off-take rate

1. Introduction

Given the natural resource base of South Africa, livestock production is one of the most important farming practices in the country. Of the approximately 80% of the land surface being utilised for agriculture, almost 70% is suitable for animal husbandry. The South African red meat sector contributed 15.4% to the total gross value of agricultural production during the 2011/2012 season with cattle being the main contributor at 10.7% while sheep contributed 2.5% during the same period (DAFF 2013). The long-term average contribution of the red meat industry to the total gross value of agriculture production (from 2000/2001 to 2011/2012) accounted for 14.2% and that of beef 9.7% and sheep 2.4% during the same period (DAFF 2013).

The South African primary red meat sub-sector is unique due to the dualistic nature of the country's agricultural situation. There is a clear distinction between the commercial (formal) sector of the industry and the smallholder (largely informal/communal) sector. The informal sector can also further be divided into two sub-sectors namely: the small-scale subsistence producers and the emerging producers. Typically small-scale subsistence producers will keep livestock, which is unique throughout the African continent, for status reasons or as a form of a “bank on hooves” and in some cases as draught power. Animals will mostly be sold in times where producers are cash strapped and are usually only slaughtered for religious or festive reasons. In this sub-sector there is little to no herd management practices in terms of the introduction of new genetic materials, calving seasons and health management practices amongst others; this is mainly due to insufficient infrastructure requirements in the communal farming areas.

The informal sub-sector contributes very little towards the industry in terms of production (measured as calving rate and off-take rate). These animals also follow a unique value chain and seldom enter the formal red meat value chain.

The second non-commercial group, emerging red meat producers differ from the small-scale subsistence producers mainly because of the reason they keep animals. In the emerging sub-sector the producers keep animals for economic gain with the main objective being reproduction in order to sell surpluses into both the informal and the formal market. Management practices are more defined and sophisticated and the calving rate is therefore substantially higher than in the small-scale subsistence sub-sector. This sector is for all intensive purposes the same as the commercial sector.

Informal livestock producers’ market access is nevertheless limited by a number of factors. These factors include, amongst others, the poor quality of animals produced; the poor performance of herds in this sector; inconsistent production; poor pasture management and rising animal feed prices increases production costs and deplete margins; little knowledge regarding animal health and disease control as well as limited knowledge with regard to animal improvement in the form of scientific breeding processes; distorting government policies; the lack of proper information and the timeliness thereof and high transaction costs (Coetzee *et al.,* 2005; Spies, 2011).

Coetzee *et al.* (2005), identified five main marketing constraints faced by small scale farmers in South Africa, confirmed by Spies (2011) in the Free State province; these includes the poor condition of the livestock, the lack of marketing information, the unwillingness and inability to adopt livestock identification practices, the lack of infrastructure and poor production and marketing management.

Apart from the aforementioned issues, the red meat industry in South Africa faces several other problems, similar to those experienced by various international meat producers. These include, amongst others, sub optimal growth in consumption figures, import threats, inappropriate policies and regulations, inconsistencies in quality and not adapting fast enough to consumer tastes and preferences.

2. Approach and data used

As a starting point, a random sample was drawn from a list of red meat producers provided by the Free State Red Meat Producers Organisation (FSRPO) as well as a number of farmers’ associations and groups throughout the province. A total of 745 producer contact names and numbers were obtained to populate the sample. A Short Message Service (SMS) text message was sent to these producers to inform them about the survey and they were asked to provide assistance if they were contacted for an interview. Producers were then contacted individually to schedule interviews, which took place during February and March 2010, and data collected applicable to the 2009 production season.

There are approximately 7,515 farming units in the Free State province. This does not, however, imply that there is the same number of producers. This is mainly due to the fact that in most cases, farmers own more than one farming unit. Producers registered as members of Free State Agriculture totaled 4,556.

A total of 143 producers were surveyed (i.e. 19% of the producer list compiled). These producers are all commercial livestock producers; there are no details available for informal producers, these farmers were surveyed at dusk when they brought their animal to the pens to overnight; informal producers on communal areas around 21 towns throughout the province were surveyed. There are approximately 2.38 million cattle and 4.98 million sheep in the province, with 4 feedlots with standing capacities exceeding 10,000 animals.

3. Results and discussion

3.1. Herd composition

The herd composition of the formal sector (Figure 1) is as follows; adult females contribute 45 and 44% to the total cattle herd and sheep flock respectively, while young female animals contribute 13% of the cattle herd and 11% in the case of the sheep flock. The total representation of breeding females (younger female animals used for breeding purposes and adults) in the cattle herd is 58 and 55% in the sheep flock. Calves and lambs accounted for 36 and 41% of the total respective herds/flocks.

In the informal cattle sector, adult, and in most cases old unproductive female animals, make out 70% of the herd with only 4% of the herd being younger female animals. The informal sheep flock has 72% old ewes, 11% young ewes and only 10% lambs (sheep farming is not common in the communal farming sector as the losses due to stray animals, particularly dogs, are too high). These herd compositions contributes to the low performance of the informal sector as only a small number of productive animals are included in the herds.

3.2 Performance of the red meat sectors

Calving/lambing rate

Depending on the source (sources vary due to the lack of reliable or accurate information), the national calving rate, defined as the number of calves born per active adult female animal, for the commercial sector ranges from 55 to 65%. Some sources indicate levels as low as 45 and as high as 80% in some cases. Given the abovementioned, it is clear that there is a high level of variance between different sources. Scholtz and Bester (2008) estimated the national commercial calving rate at 61%. However, in this study, the commercial calving rate for the Free State province is calculated at 80%, which is relatively higher than the estimated national average of between 55 and 65%. This above-average calving rate for the Free State province could be attributed to a number of factors, including better management practices, better genetic material and good pasture management. Given the national commercial averages for lambing percentage at 102%, the average lambing percentage for the Free State province is slightly lower at 93%.

National estimations on the calving rates of the informal/communal sector include those by Clark *et al.* (2005) at 40% and according to Madzivhandila et al.. (2007), between 43 and 64%; while Scholtz and Bester (2008) estimated the national calving rate in this sector at 26.9%. For the Free State province, the smallholder calving percentage was calculated at 29.8%, which is

10% below the national average of 40% as estimated by Clark *et al.* (2005). The lambing rate for the smallholder sector of the province is even lower than the calving rate at 13.2% (mainly due to high losses to stray animals). These low levels of productivity can, to a large extent, be attributed to the communal nature of livestock production systems under which the communal farmers operate. Breeding programs, such as selective breeding, and even calving seasons cannot be managed properly due to the lack of basic infrastructure, such as fences, in these communal areas.

In terms of the productivity of the livestock sector, not only in the Free State province but for South Africa as a whole, these low productivity figures for the informal sector present a huge challenge, as approximately 35 to 40% of the total herd is owned by informal producers. Assuming that this ratio is applicable to the Free State province the number of cattle in the province amounts to 833 thousand (Table 1). The current situation implies a 50% male/female ratio in the informal herd, if 40% of these are productive at the current calving rate of 29.8%, 49,647 calves would be produced totaling 12.4 thousand tonnes carcass weight equivalent (c.w.e). However, if this could be improved to 65% (the estimated national average) by adapting the herd composition to at least 60% female animals, by selecting genetic material so that the productive female animals average 65%; 211,166 calves could be produced or 52.8 thousand tonnes (c.w.e). Thus, with the correct management practices in terms of herd compositionv and by selecting the best animals for breeding purposes a 35 percentage point increase in the calving rate can increase production volumes by 325%.

Table 1. Current and possible production scenarios for the informal cattle sector.

Item	Current	Possible
Total number of animals (head)	833,000	833,000
Female animals in herd (%)	50	60
Female animals (head)	416,500	499,800
Breeding cows (%)	40	65
Calving rate (%)	29.8	65
Calves produced (head)	49,647	211,166
Weaner price (R/Kg)	17.2	17.2
Carcass weight at slaughter (kg)	250	250
Meat produced (tonnes)	12,412	52,791
Total off-take at 200 kg (R)	170,487,111	725,142,327
Difference from current (R Total)		554,655,216

Off-take rate[1]

Research done on the South African non-commercial livestock sectors showed that these sectors have not yet reached their full potential (Paterson, 1997; Ainslie *et.al.,* 2002; Clark *et al.,* 2005; Montshwe, 2006). The off-take rate for non-commercial sector, which includes the emerging and communal/smallholder sectors, is estimated at between 7.5 and 10%, which is significantly less than the estimated 25% of the commercial sector (Montshwe, 2006; RMRDT, 2008). Scholtz and Bester (2008) estimated the South African emerging and communal/smallholder beef off-take rates at 25 and 6% respectively. This study estimates the off-take rate for the smallholder beef sector in the Free State province at 11.8%; which is much higher than the national average of 6% estimated by Scholtz and Bester (2008) but significantly lower that the commercial beef off-take rate for the province (33%).

In terms of the sheep off-take rate, this study estimates the Free State province off-take rate for the communal sheep sector at 2.3%, which is very low considering the estimated off-take rate of 35% for the commercial sector in the province.

1 Also known as the marketing rate i.e the percentage of animals marketed of total herd size.

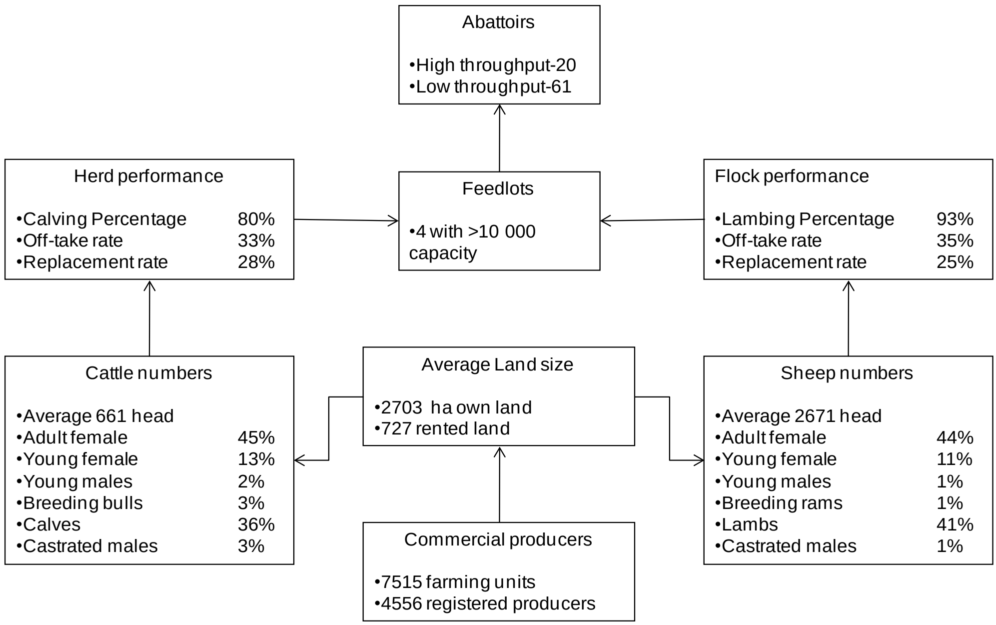

Figure 1. Summary of the performance of the commercial red

3.3. Marketing channels utilised by producers

Figure 2 shows the existing marketing channels utilised by the commercial sector, these channels are not limited to commercial producers, but also accessible to the informal sector. It is

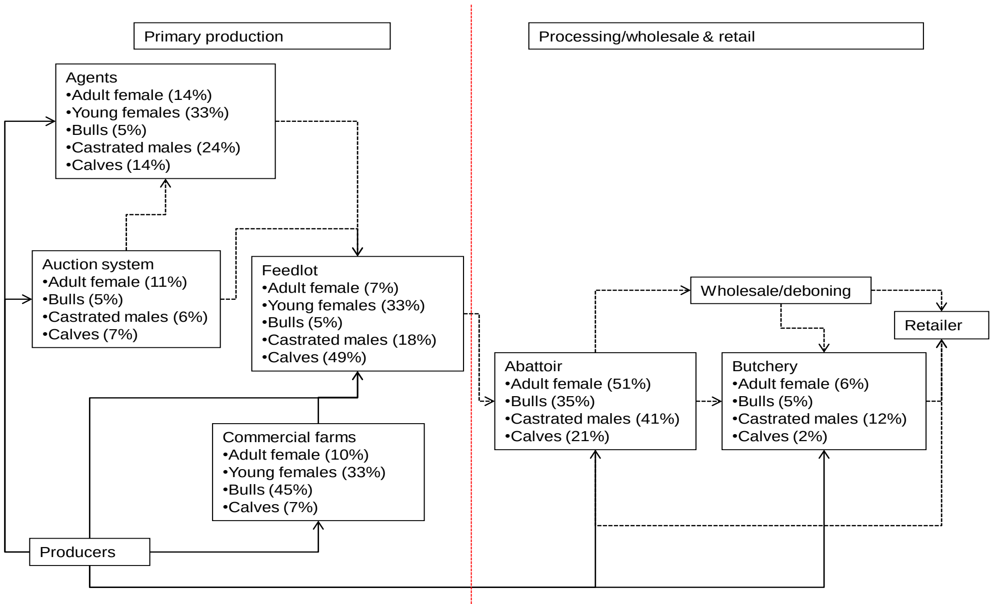

Figure 2. Marketing channels utilised by commercial producers

evident that for slaughter animals the majority of producers market directly to the abattoir, while younger animals and calves are mainly marketed directly to the feedlot. Interesting to note is that young female animals are marketed equally between commercial farms (for breeding purposes), feedlots (for slaughtering) and to agents (either for the breeding our slaughter markets). The auction system is used to a lesser extent, compared to a decade ago when this channel was the main marketing point.

4. Conclusion

It is clear from the analysis that there is ample scope to improve the performance of the informal red meat sector. With best practices in terms of production it is possible to increase the cattle production in this sector by 325%. There are however a number of challenges in this regard. One of the main challenges is the lack of infrastructure in the informal/communal farming sector, that inhibits proper herd and pasture management. Another constraint is the inability of the informal producer to access credit; mainly due to the fact that they do not have ownership of the land they produce on. This is also a disincentive to improve and maintain infrastructure on communal land.

The marketing channels do exist, as can be seen from the markets that the formal sector utilises, the challenge is to link the informal producers to these markets. The only way this will be possible is for the informal producers to produce a product that reflect the requirements of the formal sector in terms of product quality and constancy. Therefore there is an urgent need for education, training and guidance with regard to animal production in this sector. This gap could be filled by training extension officers to assist informal producers.

5. Recommendations

Efforts to improve the infrastructure in the informal/communal production areas are crucial. This should include, but should not be limited to; proper fencing and camps to provide for herd-, pasture- and breeding management; watering points; animal handling facilities to provide health care as well as collection points for animals etc. Improvements in infrastructure will not be viable without an incentive to maintain the infrastructure.

New models should be developed to provide security for credit access based on production. Analytical tools and frameworks that provide guidance into the functioning of the informal sector are important; to understand whether such models will have positive or negative impacts on producers, and to what extent the poor can benefit from these models should be analysed. Training of extension officers to guide informal producers in terms of animal production practices should be prioritized to increase productivity in this sector. It is also recommended that government should be assisted in terms of policy reform towards effective informal agricultural systems.

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SHOULD SMALL FARMS RAISE THEIR OWN REPLACEMENT HEIFERS?

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The Samuel Roberts Noble Foundation

Abstract

In the southern Great Plains of the United States of America, farmers are trying to determine the most profitable way to restock their cow herds after the droughts that have occurred since 2003. During this time, farmers reduced their herds by nineteen percent. In 2003, this seven state area, the southern Great Plains, contained forty percent of the United States' cow herd. This paper addresses the questions relative to the profitability of a small farm raising their own replacement heifers to expand their existing cow herds. Given the resources of small farms; if a portion of the resources are used for raising replacement females, does it add or subtract from the overall financial wellbeing of the whole farm? In addition, estimates are derived for the cost of farms to create their own replacement females based on when heifers have their calves and the number of cows in a specific herd. Published data from the Kansas Farm Management Association was used to create enterprise budgets and graphs depicting the profitability of heifer retention for different sized cow herds. The results show that a small farmer using their finite resources towards internal expansion does not increase their overall farm profitability. These results show that it is more cost-effective for small farms to purchase their replacement females from larger ranches who have economies of scale, regarding replacement heifer production.

Keywords: replacement heifers, small farms, profitability

1. Introduction

The southern Great Plains have been in a drought since 2003 causing farmers to destock their cow herds to match the new carrying capacity of the land. The states that make up the southern Great Plains are: Arkansas, Kansas, Louisiana, Missouri, New Mexico, Oklahoma and Texas. These seven states collectively, from the January first cattle inventory report of 2003, to the January first cattle inventory report of 2013 showed a reduction in beef cow numbers of 2,502,000 head according to the United States Department of Agriculture (USDA, 2013). This was a drop of 19.2 percent in a region of the United States that on January 1st, 2003 contained 40 percent of the nation's beef cow herd. This decrease in cattle in the southern Great Plains has contributed to a significant shift in the United States' cattle industry.

The size of individual beef cow herds in the southern Great Plains varies dramatically. There are 235,831 farms that have 49 or less cows, 64,081 farms that have 50 to 499 cows and 1,905 farms that have 500 or more cows (USDA, 2012). These three groups respectively have a total of 3,904,532 cows, 7,305,622 cows and 1,707,632 cows. In 2007, the average beef cow herd was 43 head in the southern Great Plains. Typically, a producer will need to replace approximately fifteen percent of the breeding females each year. This equates to six replacement heifers needed for the average size herd in this region.

Farmers in the southern Great Plains are continually evaluating how and when beef cow herd expansion will begin. When rainfall returns, and the carrying capacity of the land increases, farmers of all herd sizes will be looking for the most economical way to increase their herd.

The production system of a beef cow is a lengthy process. It is longer than most meat protein sources such as goat, sheep, chicken, pork and fish. The production interval for a cow is between 16 and 30 months depending on the breed and the age of maturity of the animal. With such a lengthy production system, it is vital to a farm's financial success to have a business plan and to create strategies that make sense both from a production and financial perspective.

The predominate calving period for cow herds in the southern Great Plains is during spring. A spring calving period would typically consist of calves born between January first and May first. These spring-born calves are typically weaned in the fall, around October first. Heifers weaned at this time should weigh approximately 227 kilograms, depending on breed and growth potential. Bos taurus breeds should reach puberty at about 60 percent of their mature weight (National Research Council, 2000). However, Bos indicus breeds mature at a later age and at approximately 65 percent of their mature weight (National Research Council, 2000). This is important to know and should be used to ensure heifers are developed to reach this target weight prior to breeding. In addition, heifers have a longer post-partum interval (Taylor and Bogart, 1988) and it is generally recommended that heifers are bred to calve one month prior to the mature cow herd to increase their opportunity to rebreed. If a farmer is trying to develop a replacement female for a herd that calves the first of January, heifers will have to reach puberty and become pregnant by February 25th to calve by December first. This paper will address the production steps and costs associated with developing a heifer from bull turn out to having the first calf.

2. Methods

Published data from the Kansas Farm Management Association was used in conjunction with stated assumptions regarding scenario analysis to create multiple enterprise budgets based on various herd sizes. The results from multiple enterprise budgets were graphed to depict the profitability of heifer retention for different sized cow herds.

The costs associated with developing and breeding replacement heifers are detailed in Table 1. This enterprise budget is for a farmer developing his own replacement heifers and begins when the management decision is made to turn out the bulls to breed the heifers. Therefore, the enterprise budget shows the market value of the heifer at the time it is to be bred and the cost of pasture allocated to the heifer from the point it is bred until the calf is born. The enterprise budget takes into account the cost of supplemental feed for 90 days, mineral for 270 days, pre-breeding vaccinations, fly control, dewormer, bull expenses and the cost to check pregnancy status. Morbidity at five percent and death loss at one percent are also included. This enterprise budget assumes labor at $11 an hour with a base time spent per day of thirty minutes and two minutes per day for each additional heifer.

Both the herd and heifer bulls were assumed to be purchased for $3,500 each and have the ability to breed 25 heifers. In the situation where a herd bull is used to breed the heifers, the bull is assumed to have the ability to cover a combination of 30 cows and heifers. This is because the bulls are being turned out for 30 more days given the heifers are bred to calve 30 days prior than the cow herd. Each farmer will need to decide whether to use an existing herd bull or use a heifer-specific bull that has acceptable birth weight and calving ease for breeding heifers. To stay within the budgeted price, if a herd bull was acceptable for breeding heifers it was assumed that growth performance of each calf was decreased by 4.54 kilograms at weaning (Table 2). It is possible to purchase bulls with high growth performance and are acceptable for heifers, but at a greater purchase price.

The second part of the enterprise budget shows other costs associated with breeding replacement heifers from a farmer's own cow herd. The first line shows the value of the heifer prior to breeding. A farmer forgoes the option of selling the heifer and instead makes the management decision to have her bred. Line two shows the non-recoverable costs allocated to open heifers that did not become or remain bred until the time pregnancy status was checked. These costs have to be spread across the heifers that do get bred. The third line is the dollar amount of how much more or less the open heifers would be worth when sold, spread across the bred heifers.

Table 1. Costs associated with breeding 28 replacement heifers to calve December first using heifer-specific bulls

Operating Inputs	Unit	Price		Quantity	$/Head	
Forage	Head	$	18.00	9.00	$	162.00
Supplement	Kg	$	0.35	326.00	$	115.21
Mineral	Kg	$	1.28	30.62	$	39.19
Vaccinations	Head	$	8.00	1.00	$	8.00
Death loss	Head	$	1 337.59	1.0%	$	13.38
Sickness	Head	$	25.00	5.0%	$	1.25
Pregnancy check	Head	$	6.00	1.00	$	6.00
Labor	Head	$	11.00	14.01	$	154.15
Heifer bull	Head	$	36.79	1.00	$	36.79
Annual cost for bull	Head	$	600.00	7.0%	$	42.86
Operating Cost					$	578.81
Value of unbred heifer at breeding	Head	$	145.50	725.00	$	1 055.00
Non-recoverable cots of opens	Head	$	406.14	15.00%	$	60.92
Sale of heifer	Head	$	(192.13)	15.00%	$	(28.82)
Opportunity cost of alternative enterprise	Head	$	200.00	75.00%	$	150.00
Opportunity cost of not implanting	Kg	$	2.76	11.34	$	100.50
Total Other Costs					$	1 337.48
Total Costs (Opetating + Other) per Heifer					$	1 916.29

Next, the opportunity costs involved with retaining and breeding heifers are considered. A farmer that chooses to use his or her resources to develop replacement heifers chooses to give up other enterprise options during that same time period. The enterprise budget assumes the producer would net $200 profit per cow, each year, and is foregone because of raising replacement females. Based on animal units, a single heifer utilizes the same amount of pasture that three fourths of a cow could be using and is the ratio used in calculations.

Finally, if the farmer chooses to retain heifers, there is a missed opportunity to use a growth implant in all of the heifer calves because at the time the implant would be administered, it would be unknown as to which heifers would be retained and which ones would be sold.

These assumptions and their associated costs were used to evaluate four scenarios: breeding replacement heifers to calve December first using heifer-specific bulls, breeding replacement heifers to calve December first using existing herd bulls, breeding replacement heifers to calve April first using heifer-specific bulls, and breeding replacement heifers to calve April first using existing herd bulls.

Table 2. Costs associated with breeding 28 replacement heifers to calve April first using existing herd bulls

Operating Inputs	Unit	Price		Quantity	$/Head	
Forage	Head	$	18.00	9.00	$	162.00
Supplement	Kg	$	0.35	326.00	$	115.21
Mineral	Kg	$	1.28	30.62	$	39.19
Vaccinations	Head	$	8.00	1.00	$	8.00
Death loss	Head	$	1 535.56	1.0%	$	15.36
Sickness	Head	$	25.00	5.0%	$	1.25
Pregnancy check	Head	$	6.00	1.00	$	6.00
Labor	Head	$	11.00	14.01	$	154.15
Additional Herd bull	Head	$	3 500.00	0.00	$	-
Annual cost for bull	Head	$	600.00	4.0%	$	22.36
Operating Cost					$	523.51
Value of unbred heifer at breeding	Head	$	141.60	905.00	$	1 281.00
Non-recoverable cots of opens	Head	$	350.84	15.00%	$	52.63
Sale of heifer	Head	$	(122.52)	15.00%	$	(18.38)
Opportunity cost of alternative enterprise	Kg	$	2.76	4.5359	$	68.44
Opportunity cost of alternative enterprise	Head	$	200.00	75.00%	$	150.00
Opportunity cost of not implanting	Kg	$	2.76	11.34	$	100.50
Total Other Costs					$	1 634.66
Total Costs (Operating + Other) per Heifer					$	2 158.17

3. Results and discussion

When the budget presented in Table 1 is analyzed for different herd sizes, the costs per replacement heifer changes (Graph 1). In the first scenario, heifers are bred to calve December first using heifer-specific bulls. The cost to raise one heifer is $4,791, $2,267 per head to raise six heifers and $1,916 per head to raise 28 heifers. In scenario 2, heifers are bred to calve December first and we assume that an existing herd bull is acceptable for breeding heifers. Given the same production system and costs, the cost to raise one heifer is $3,574, $2,125 per head to raise six heifers and $1,897 per head to raise 28 heifers (Graph 1). This shows that while it is more economical to use an existing herd bull, the costs attributed to purchasing a heifer-specific bull are six percent of the total costs when raising six or more heifers.

The effect of breeding date on the costs associated with developing replacement heifers was also considered for different herd sizes. When the budget presented in Table 2 is analyzed for different herd sizes, the costs per replacement heifer changes (Graph 2). In the third scenario, heifers are bred to calve April first using heifer-specific bulls. In this case, the cost to raise one heifer is $5,029, $2,507 per head to raise six heifers and $2,156 per head to raise 28 heifers. This shows that waiting to breed the heifers at a later date increases replacement female costs for all herd sizes. In the final scenario, heifers are bred to calve April first and we assume that an existing herd bull is acceptable for breeding heifers. The costs associated with developing one heifer are $3,901, $2,390 per head to raise six heifers and $2,158 per head to raise 28 heifers.

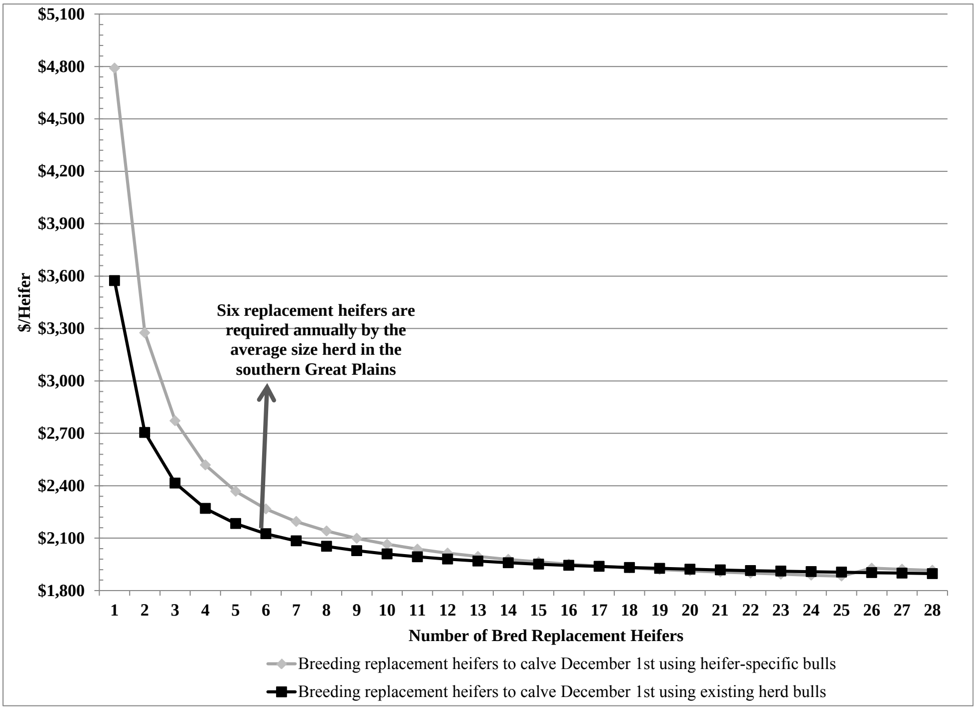

Figure 1. The Cost to Develop Bred Replacement Heifers

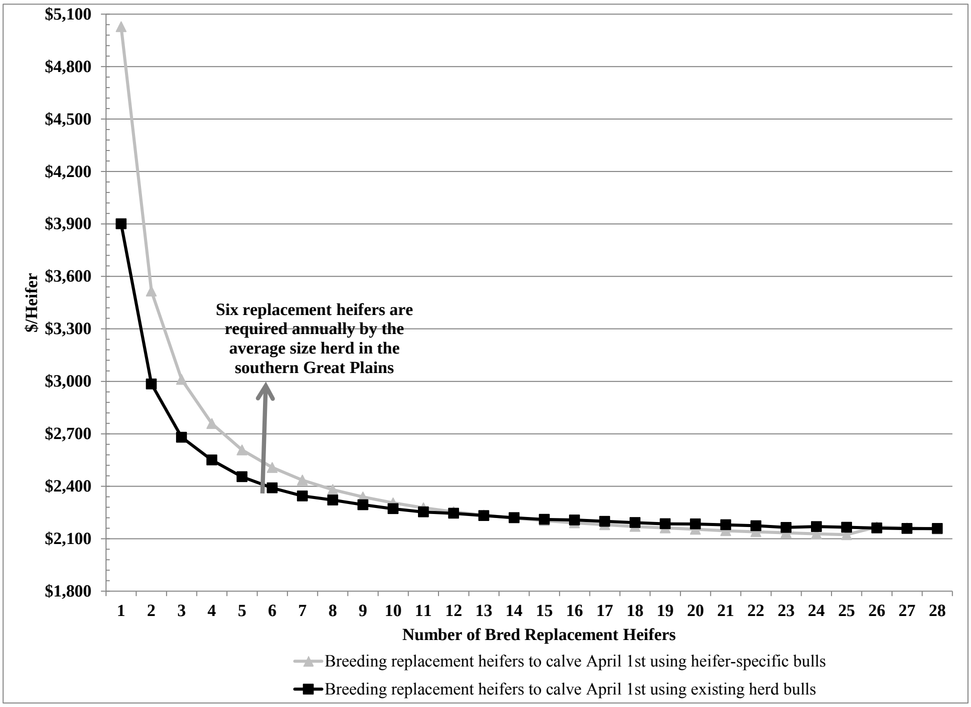

Figure 2. The Cost to Develop Bred Replacement Heifers

Based on these scenarios, heifers bred to calve December first would have the lowest cost of production and if an existing herd bull could be used, costs could be decreased further. Additionally, calves born earlier in the year will be heavier at the traditional October weaning time. However, the additional supplement required to calve at this time can be expensive and should be considered.

There are significant price differences for farmers raising their own heifer replacements depending on the number of replacement heifers produced, what bull is used and calving date. The cost of producing a replacement heifer can vary between $5,029 and $1,897 based on the assumptions used in these scenarios. As expected, the difference in production costs across scenarios is greater for the smallest herds and could be as great as $1,455 per head.

The average herd size in the southern Great Plains is 43 head, requiring about six replacement females each year. Depending on the market price and availability, it might make the most economic since for these farmers to purchase replacement heifers from a larger farm that has economies of scale. Raising six replacement heifers at a time is not the most efficient use of labor. In addition, heifers should be managed separate from the mature cows to increase production efficiency but this can add significant management complexity. Larger farms can capitalize on labor, breeding and management efficiencies to reduce production costs.

As the opportunity arises for herd expansion in the southern Great Plains, farmers will need to evaluate their resources and determine to most profitable method of expansion. For the average spring-calving herd in this region, developing heifers to calve December first is the most profitable scenario of those analyzed. However, the market price and availability of bred heifers could make it more economical to purchase replacements. Hopefully, this information will provide the information necessary to make the most profitable decision.

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AN AGENT-BASED SIMULATION MODEL OF WESTERN CANADIAN PRAIRIE AGRICULTURAL STRUCTURAL CHANGE

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Abstract

Western Canadian prairie farms are commonly stereotyped as large-scale grain farms located on flat lands that stretch to the horizon, but this misrepresents the diversity of farm operators, the landscape and the prairie ecosystem. This diversity has a profound impact on farm structure and competitiveness. Of particular interest are economically transitional or marginal lands between use in annual crops, forage and pasture. The primary objective of this research is to assess transitional land use, beef cow numbers, farm structure and performance under alternative price scenarios. Individual and sector performance is simulated over a period of 30 years using an agent based simulation model (ABSM). A "synthetic" farm population of 600 individual farming agents is constructed based on statistical data and located on an existing landscape of 341,530 hectares. Important model features are 1) segmented farmland auctions consisting of a primary farmland purchase market and a secondary leasing market; 2) a formalized business and farm expansion model that takes into account farm size, asset lumpiness, machinery technology and replacement policy; 3) individual agent expectations based on prior experience and risk aversion; 4) two basic farm types: grain farms and "mixed grain-cow" farms and 5) farm succession. Individual farming agent land use, success or failure in farmland markets and business prosperity are tracked over 30 years and through 100 different price and yield time paths. These are consolidated into a database and sector population statistics and farm structure are analyzed. Past economic trends such as declining farm numbers and increasing farm size are projected to continue; these trends are robust as they are generated under many different time paths and scenarios. Beef cow numbers depend upon land use which is sensitive to agent farm type preferences and wheat-beef price ratios. Large grain price increases have a more dramatic impact on industry structure by creating large structural shifts towards more grain and eventually fewer mixed farms. However, large changes in livestock prices generate smaller structural shifts over time because of the many lags and difficulties in expanding beef cow production.

Keywords: farm structure; Agent based simulation model

1. Introduction

Western Canadian prairie farms are commonly stereotyped as large-scale grain farms located on a flat landscape that stretches from horizon to horizon. However, this image misrepresents the diversity of farm operators, the actual landscape and the prairie ecosystem. Western Canadian prairie farms consist of numerous individuals with diverse financial and demographic characteristics located on a highly heterogeneous landscape. Of particular interest are lower quality and transitional soils representing about 43% of Canadian Prairie farm land. These lands are of con-

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siderable environment concern and are “transitional” in that they are at the economic “margin” between annual crops and forage/pasture. Much of forage and pasture land is generally used in beef cow production (or dairy) and not directly marketed; hence, transitional land use is ultimately tied to the comparative profitability of livestock over grains. Further, land conversion from one use to the other is a longer run decision and is subject to farm operator preferences/aversion to livestock. The latter is particularly important as it means that shifts in marginal land use generally occur only when land changes hands. This is inherently complex because of the cascading effect of internally generated land rents into subsequent land purchase and leasing decisions which ultimately affect farm survival and succession.

In the following sections, an agent based simulation model (ABSM) of a grain and mixed grain-beef cows farm population is developed for an existing farming region. Farm level production of grain and beef is subsequently tracked over 30 simulated years. Two alternative price scenarios are formulated and farm structure is re-simulated in order to evaluate the effect of price shifts on regional production. We conclude by examining longer run structural impacts of changing grain-beef calf prices.

2. An ABSM of grain and mixed grain-beef cow farms

Because of the nature of the farms in our study area, we do not incorporate as explicit a bio-economic model of land-pasture-cow-manger interaction as Gross et al (2006) and McAllister et al (2006), but emphasize more of the whole farm business and financial management, more in the style of the AgriPoliS model (Happe, Balmann, Kellermann, 2004), Freeman (2005) and Anderson (2012). We build on the Freeman model by introducing: 1) a more formalized model of machinery investment lumpiness; 2) a more explicit relationship between farm size, machinery technology and replacement policy; 3) the inclusion of beef cows and “mixed farms” with associated lower farmland quality; 4) a segmented purchase and leasing farmland market with the inclusion of non-farmer investors; and 5) spatial diseconomies with farm size (Stolniuk, 2007).

In brief overview, regional agricultural structure is a complex evolving system consisting of a heterogeneous population of farmer agents, each seeking to grow and prosper. These agents are located on a heterogeneous farm landscape and these agents interact with each other in farmland auctions over a geographical space dominated by yield and price uncertainty. Within a farmer age bracket and under certain financial conditions, the inherent desire of farmers to grow and prosper compels them to expand their operations. This leads farm agents to compete in land purchase and leasing auctions by tendering bids based on their own expectations as to future farm profitability for farmland that varies in land quality and location. Innate but differing levels of risk aversion, random price and yield events and errors in bid formulation lead to differing bid values in land auctions. Farmer agents who bid and end up paying too much for farmland can find themselves in financial stress, and subsequently be forced to downsize or to exit. Farmer agents who consistently bid too little will be unable to expand, making them progressively less competitive, leading to stagnation and over a lifetime, unable to generate sufficient equity to pass their farm on to the next generation.

Farmland pricing information generated by our auctions generates a “balance sheet effect” feedback loop where increased/decreased asset value based on current auction value, increase/decrease a farm’s ability to secure additional credit. This effect is further enhanced by financial leverage. Farmland pricing is also used to set lessors’ expectations as to “fair market” cash leases. Accordingly, regional structure over several generations is determined by the personal and business characteristics of the remaining farmer agents. In the next sections, we discuss the landscape, as well as our synthetic agent population and their characteristics and farmland auctions.

The simulated landscape is based on Census Agricultural Region (CAR) 7B, located in the dark-brown soil zone of west-central Saskatchewan, a province in western Canada. CAR 7B has a total of 1,740 farms and 1.3 million hectares of land in farms (2006 Agriculture Census of Canada). The CAR is divided into 259 h (640 acre) plots, each plot having a unique land use profile consisting of 1) tillable, 2) hay, 3) improved pasture, 4) natural pasture, and 5) non-agricultural land and associated crop yields. Tilled land can be used as improved pasture, hay, or annual crop production. Hay lands are used as hay (typically first cutting) or pastured if there is a projected surplus of hay. Improved pasture can be used for first cutting hay if there is a projected forage deficit, but more typically it is pastured. Natural or unimproved pasture is used only as pasture land, while non-agricultural land is unsuitable for agricultural use. Individual plot potential land use, pasture animal unit carrying capacity and productivity are derived from Saskatchewan Assessment and Management Agency (SAMA) assessment and Saskatchewan Government Crop Insurance data (Saskatchewan Agriculture and Food, 2010). Finally, plot location is important as it determines land quality and it affects transportation costs from the field to the farmstead.

There are four types of agents: 1) farmer-operators, 2) retired farmer landlords, 3) non-farming landlords, and 4) an auctioneer. Farmers purchase and rent land for grain and livestock production while non-farming land owners hold land solely as an investment. The auctioneer coordinates land markets between the sellers and individual bidders. Farming agents are endowed with different resources, abilities, and demographic characteristics. Farm business resources include capital, land, and labor and are used by farm agents to generate income and wealth. Agents also vary in their risk and livestock production preferences/aversion.

There are two types of farmer agents according to their preferences/aversion to livestock: grain farms and mixed grain beef-cow farms. Grain farmers have an innate strong aversion to beef cows and they cannot be induced to switch into beef production. These farms tend to have more annual crop land, and because of their relatively greater size have achieved greater economies of size than mixed farms in grain production. Grain farmers seek out better cropland as much as possible; on the poorer quality land they sell hay or lease out pasture land and incur transaction costs associated with forage transportation and marketing. A "mixed" farm has both grain production and beef cows and can expand towards either enterprise. When a mixed farm increases livestock numbers, there are no additional fixed costs as the existing plant is assumed to be capable of handling larger herds. Mixed farms do not incur costs in selling hay or leasing out pasture as they use forage lands for their own livestock production. Therefore, they have a competitive advantage in bidding for poorer quality and transitional land. Conversely, grain farms have a competitive advantage in bidding for better quality land which has little hay or pasture because of their size advantages.

While our landscape is based on actual provincial land characteristics, our farm population of 600 farmer agents is synthesized based on the Whole Farm Survey for CAR 7B (Statistics Canada, 2007) and the 2006 Canadian Census of Agriculture. Important farm agent business characteristics include farm type ("grain" or "mixed"), farm size, tenure, relative debt, land value and livestock numbers. Important farm agent personal characteristics include age, grain/livestock preferences and off farm income. Individual agents and their associated businesses are matched to approximately 4500 actual farmland plots of 259 h (640 acres) according to their relative land value per hectare and relative amount of pasture. In the case of mixed farms, herd numbers are set by the associated cow carrying capacity of their individual land. Individual land tenure is based on their business characteristics.

Initial individual farm size is important as it sets the subsequent appropriate tillage technologies and machinery replacement patterns described in the following sections. Initial farm assets are based on farm size and the corresponding machinery technology and land is valued at current fair market value; farm debt is based on total farm assets times the relative debt level. Age and off farm employment income are assigned using a similar method.

3. Simulation procedure

Farmland auctions and farm structure are simulated using Version 3.1.4. of the NetLogo© simulation software (Wilensky, U. 1999). Netlogo is a widely used platform for ABSM research (Railsback, Lytinen, Jackson 2006). For tractability, only a 32% sample and corresponding land plots are randomly selected from the total population. Our sample consists of 600 farmers located on 341,530 hectares with an average farm size of 585 hectares, and an average farm operator age of 52 years.

A total of 100 different price and yield 30-year time paths are created using a bootstrap style procedure based on historic detrended yield and prices. Three key scenarios are examined. The first scenario or base scenario is based on historic prices and yields. The second scenario (HiCropPrice) represents a permanent structural shift in the grain markets leading to a 25% increase in grain prices over the base. The third scenario (HiCalfPrice) represents a permanent shift in livestock markets resulting in a 25% increase in calf prices over the base.

4. Model validation

It is inherently difficult to validate certain ABSM simulations, particularly those that simulate future longer run trends. Farmland pricing is chosen as our primary validation variable as it incorporates most of the fundamental economic and accounting relationships, and because farmland prices are completely endogenous and a result of the individual agent bidding formulation and the subsequent auction process. Because historic CAR 7B farmland prices are unavailable; validation is based on comparisons of simulated 1975 to 2004 CAR 7B farmland values to historical provincial farmland value averages. In order to check their goodness of fit, simulated values are regressed on the corresponding provincial farmland value using a simple linear model and ordinary least

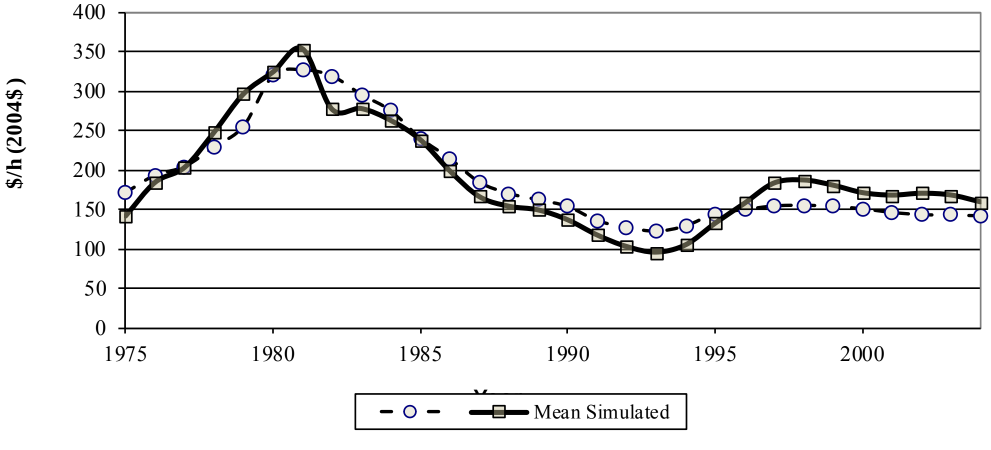

Figure 1. Comparison of Normalized Mean Simulated to Historic Land Prices

squares. Simulated farmland prices compare reasonably well: the adjusted *r* square is 0.88. The estimated coefficients with their *t* values in parenthesis are for the intercept: \$2.75 (0.184) and the β estimate: 1.088 (14.556). Thus, the intercept is not statistically significant from zero but the β estimate is highly significant from zero. Note that comparisons are based on different geographic areas, so that it would not be expected that the β estimate would be equal to 1.

In order to better evaluate the two series, the simulated data are normalized to give the same mean as the provincial data and turning points and trends assessed (Figure 1). Overall, we find that the simulated land values tend to overreact, which might be caused by comparing a local market to a much larger overall provincial market.

5. Results

5.1. Base scenario

Farm structural characteristics such farm size and numbers are displayed by farm type in Figure 2 and summarized in Tables 1 and 2. In the base scenario, land use as measured by the percentage of land cropped does not change much, remaining at a constant 70% (Table 1). In addition, the base scenario displays the familiar patterns found in Canada of continued diminishing farm numbers and a corresponding increase in farm size. However, the simulated annual decrease in farm numbers of 3.7% (Table 1) is higher than a recent measured rate of 2.6% (Saskatchewan Agriculture and Food, 2010), although this annual rate has been accelerating over the last 35 years. The reason for a projected greater rate of decrease is that we project greater difficulties in farm succession as it will be progressively more difficult for families to accumulate sufficient farm equity to allow another member of the family to start farming, yet allow sufficient remaining equity for the parents for retirement living.

Table 1. Change in Mean Farm Type, Land Cropped and Herd Structural Characteristics

Structural Statistic	Farm		Proportion of mixed farms		Land cropped		Total beef cows		Farm herd size	
	numbers	% change	%	% change	%	% change	head	% change	head	% change
Beginning	600		53%		70%		19,682		62	
Ending by Scenario										
Base	191	-3.7%	61%	0.5%	70%	0.0%	20,957	0.2%	182	3.7%
HiCropPrice	277	-2.5%	56%	0.2%	74%	0.2%	14,880	-0.9%	95	1.4%
HiCalfPrice	238	-3.0%	66%	0.7%	64%	-0.3%	30,207	1.4%	196	3.9%

Note: HiCropPricesis based on a 25% increase in crop prices and HiCalfPrice in based on a 25% increase in beef feeder calf prices, % change is the average annual compounded rate of change

Total herd size is a function of land use and since land use is almost constant, herd numbers are also nearly constant, increasing at an annual rate of 0.2%. However because farm size is increasing in the simulation, mean herd size increases at a rather constant annual rate from 65 to 182 head due to fewer farms. While farms grew rapidly, much of the expansion came through additional leased land rather than purchased land. In the initial simulated farm population, 32% of farmland was leased. At the end of 30 years, mean leased lands increased to 51% (Table 2).

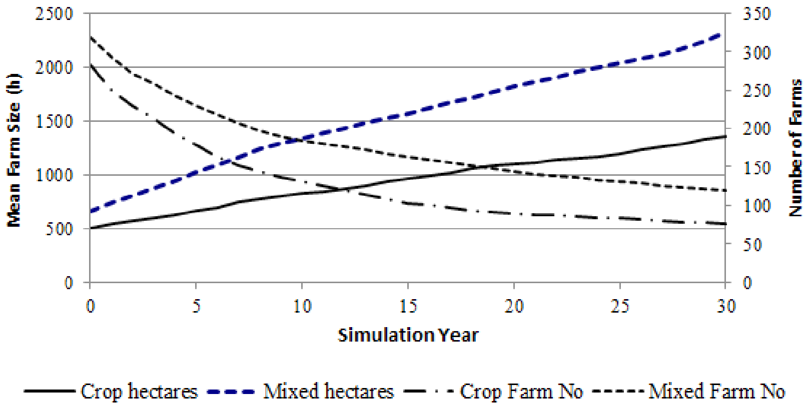

Figure 2. Patterns in farm size and numbers by farm type

Table 2. Mean Farm Business Performance Characteristics and Land Tenure

Structural Statistic	Farm Size		Net Worth		Farmland Value		Debt/Asset Ratio		Leased Land	
	hectares	% change	(x1000)	% change	($/h)	% change	%	% change	%	% change
Beginning	585		523		865		15%		32%	
Ending by Scenario										
Base	1996	4.2%	2,108	4.8%	1,544	2.0%	16%	0.3%	51%	1.6%
HiCropPrice	1284	2.7%	3,033	6.0%	2,175	3.1%	8%	-1.8%	32%	0.0%
HiCalfPrice	1556	3.3%	2,359	5.1%	1,801	2.5%	12%	-0.6%	44%	1.1%

Note: HiCropPricesis based on a 25% increase in crop prices and HiCalfPrice in based on a 25% increase in beef feeder calf prices, % change is the average annual compounded rate of change

We measure sector health by the growth in aggregate net worth, which in turn is a rough proxy for return on investment, and the debt/asset ratio, which is a measure of risk bearing ability (Table 2). Net worth in the simulation increased at an annual rate of 4.8% while the debt/asset ratio increased slightly from 15 to 16%. These figures would be considered relatively healthy by traditional farm management standards. Note the importance of increased farm land values in farm equity gains—farm land increased at an average annual rate of 2% over the period of the simulation; however, this further complicates farm succession.

5.2. Alternative price scenarios

Clearly, land use is affected by the relative price of grain to livestock. When grain prices increased (HiCropPrice Scenario), the average amount of land used in annual crop production also increased over the first seven years of the simulation and then increased very slowly to approximately 74% of total arable land. When livestock prices increased (HiCalfPrice Scenario), a mirror situation occurred: the average amount of land used in annual crops decreased over the first seven years and then stabilized to approximately 64%. These shifts are due to the nature of transitional land: it is at the economic margin between hay or annual crops. The price changes used here are close to so-called “tipping point” but change is not instantaneous as it takes time for actual prices to affect agent expectations and then be reflected in crop choices and farmland pricing decisions. In addition, the decision to decrease perennial forages is only made at the end of its normal stand and hence it takes a few years for all of the forage rotations to come up for profitability review. While the herd can be downsized relatively quickly, it takes longer to increase herd size. The subsequent, slower long- run changes are founded on the shift to/from grain mixed from/to grain-beef cow farms as land changes hands. In the case of the HiCropPrice scenario, the proportion of mixed grain-beef cow farms decreased from the base scenario of 61 to 56%; in the HiCalfPrice scenario the proportion increased to 66%.

In both of the increased price scenarios, as farm profitability increased, the rate of decrease in farm numbers slowed. The effect is most dramatic in the case of increased crop prices (HiCrop-Price). The shock of increased crop prices slowed the erosion in farm numbers from the base of 3.7 to 2.5%. Accompanying higher crop prices is increased annual growth in farmland values (2.0 to 3.1%), lowered debt-to-asset ratios (16 to 8%), decreased annual growth in farm size (4.2 to 2.7%) and decreased reliance on more leased land (1.6 to a 0.0% annual growth rate). Increasing farm equity and, in particular, non-land equity over time and reduction of farm debt enabled more farms to successfully transition from one generation to the next. In contrast to higher crop prices, higher calf prices only affect the livestock farms, and only that land which derives its value from the beef cow herd. This translates into a much lower impact on sector farm viability.

6. Conclusions

Agricultural structure in western Canada has been continually evolving since the days of homesteading, but in recent years, the causes underlying structural change have become so multi-dimensional and complex that little comprehensive research has been done to understand what changes are occurring and why. Using an agent-based simulation model of farming in Western Canada, we project that historical trends of declining farm numbers and increasing farm size will continue over the foreseeable future. These projections are remarkably robust since they are generated under many different time paths and alternative scenarios. Overall, increased grain profitability resulted in a quicker and more dramatic shift in land use than increased beef cow profitability because of 1) the lags in beef production associated with delays in expanding herd numbers; and 2) in the case of shifts from a grain only farm to a mixed farm, it is only at the time of transition from one type of farm operator to another that changes occur.

Simulated growth in farm size is subtle and is not generally due to forced exits, but instead is due to farm stagnation and/or the subsequent failure to generate sufficient equity to allow the next farm generation to enter. Historically, Canadian farm policy has tended to support the status quo, particularly through subsidizing small family farms. This has sustained many uneconomic farming operations that, under less supportive conditions, would not be able to survive the transition from one generation to the next. Our research suggests that structural change in the sector, characterized by fewer and larger farms, now appears to be inexorable. Former government goals and policies will thus be wasteful unless they are appropriately modified to the new regional economic reality.

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PROPOSED PROCUREMENT MARKETING FRAMEWORK FOR POTATO PROCESSING COMPANIES

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Abstract

The potato processing industry production has increased over the last few years with as much as 143% within 10 years; together with this there is also an increased growth in the import of frozen fries. This puts direct pressure on the processing companies to procure good quality potatoes at reasonable prices, in order to remain competitive. The aim of this paper is to develop a procurement marketing framework that will assist processing companies with the establishment of longer term contracts and relationships with producers as suppliers. This framework is constructed by evaluating the needs of producers, transaction costs, the profit margins, price risks and incentives such as Decision Support Models.

Keywords: potatoes, marketing, processing companies, South Africa

1. Introduction

The potato processing industry production has increased over the last few years with as much as 143% within 10 years; together with this there is also an increased growth in the import of frozen fries. This puts direct pressure on the processing companies to procure good quality potatoes at reasonable prices, in order to remain competitive. Given this, the producers on the other hand, have different marketing channels to choose from, namely table potatoes and processing potatoes. Meaning that the processing companies also have indirect competition from other marketing channels.

Table potatoes have a spot market governance structure where the prices for the potatoes are set on an organized market structure, namely: Local Fresh Produce Markets. In terms of processing potatoes, the governance structure is a contract structure, which uses a Decentralized Individual Negotiation (DIN) price discovery model where the prices are negotiated directly between the processing company and the producer. This means that the table potatoes (spot market) have a variable price and the processing potatoes (contract market) have a fixed price within a specific season.

Given all of this and the fact that the potato processing market is a fast growing industry, processors are struggling to procure sufficient quantity and quality potatoes from producers due to indirect competition and imports.

2. Procurement marketing

Procurement and marketing as a holistic picture is becoming increasingly important. Procurement is increasingly regarded as a strategic function in the business environment (Lamming and Cox 1995; Gadde and Håkansson, 2001; Trent, 2004; Axelsson et al., 2005; Monczka et al., 2005; Hardt et al. 2007; Piercy 2009; Sheth et al., 2009). Various authors as indicated above, have done work on this subject; Koppelmann was the only author to develop a theory.

According to Koppelmann (2003) there are a few aspects that make procurement difficult, amongst others: costs, prices, time, innovation and acceptance. With a free market system and globalisation, the competition between businesses is increasing. This means that processing companies must keep their costs as low as possible. If a company can obtain economies of scale, costs can be decreased and a final product can be provided to the consumer or the next person in the value chain for a more reasonable price and the processing companies can be competitive.

One of the problems regarding agricultural raw materials is the volatility in supply. Furthermore, South Africa does not have import tariffs on frozen fries, which allows the import of frozen fries into South Africa at relative low prices, compared to the domestic products. Another important factor in terms of the procurement of raw materials is the window of procurement. Potatoes are grown in different regions at different times in South Africa, which means that the processing company must have a comprehensive procurement management strategy.

Koppelmann (2003) identified certain theories that must be kept in mind with procurement marketing. The first theory is Coalition theory, the basic principle of this theory is that, if everyone within the business environment (staff, suppliers and directors) is satisfied, the business has long-term feasibility. The second theory is Incentive – Contribution theory highlighted by Figure 1.

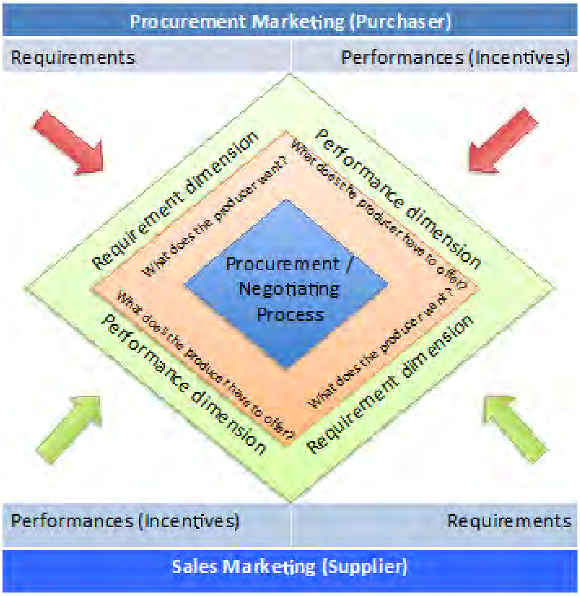

Figure 1. Incentive – Contribution theory within procurement marketing
Source: Koppelman (1998)

According to this theory, buyers will always try to purchase at the lowest cost; however, the buyer must also provide the supplier with something to convince the suppliers to sell the produce. This theory is based on two aspects namely, the requirements and the performances. The importance of the requirement is to identify the objectives of both the supplier and the buyer and to determine what the mutual requirements are to satisfy these objectives. In terms of performances the question to be answered is: What incentives are in place for the supplier if the performance is up to standard and what are the benefits for the buyer?

The aim of this paper is to develop a procurement contract and to set up an procurement marketing framework, to assist processing companies with the establishment of longer term contracts and relationships. This framework is constructed by evaluating the needs of producers, transaction costs, the profit margins, price risks and incentives such as Decision Support Models.

3. Important aspects within procurement marketing

According to Rhodes et al. (2007) procurement is based on four pillars within agriculture: Risk, Profit, Transaction Costs and Governance structures. Various studies such as Strydom et al (2012 a, b, c) and Strydom and Grové (2012) examined all of these pillars and the following results were obtained.

3.1. Contractual agreements

Strydom et al. (2012 a) investigated the perceptions of potato producers towards the processing industry by means of investigating the advantages and disadvantages of the potato processing industry, as listed below in Table 1:

To enter any contract, a sense of trust is an imperative factor. This was proved by various authors such as: Tregurtha and Vink (1999), Masuku, Kirsten, Van Rooyen and Perret (2003). The grading system creates a lack of trust, mainly because the producers do not always agree with the grading results.

In order to determine prices, the processing companies make use of a Decentralized, Individual Negotiation (DIN) method. In order to facilitate this process, a price setting model was developed. The model can be used to determine price premiums that can serve as incentives for the production of potatoes of a sufficiently high quality required for the purpose of processing. Thus, it may form part of a marketing model in order to establish longer term contracts. Producers can also benefit from using the model in decision-making, since the model allows for price risk consideration when calculating potential gross income at the proposed contract price.

Table 1. Advantages and Disadvantages when delivering to processing companies

Disadvantages		
Disadvantages	Description	Rank*
Transport costs	That all the producers pay the same transaction costs	-20.00%
Holdback	There is a holdback fee until all the contracted tones are delivered (cash flow)	-26.67%
Other companies	Can only produce for the contracted company and not other companies (diversify risk)	-26.67%
Extension officer	The use of extension officers are responsible for additional costs (small producers)	-33.33%
Grading system	The grading system is not transparent	-53.33%
Cultivars	The processing companies only prefer certain cultivars	-53.33%
Harvesting teams	The harvesting teams of the companies are inefficient	-53.33%
Advantages		
	Description	
Flat rate	Additional tones delivered after contract are priced at a flat rate	13%
Compensation	If the producer have diseases or production problems the processing company will assist	27%
Established	Some of the companies are well established	53%
Loyal experienced producers	Some of the companies have a loyal producers client base	53%
Logistics	Logistics are well organized which assist with the harvesting	67%
Extension officers	Extension officers assist in farming practices (large producer)	67%
Bulk transport	Bulk transport reduces transaction costs	80%
Processing	Processing capacity of plants are high which assist producers during harvesting	100%

* Rank according to relevance and importance the more negative the value is the larger disadvantage of the factor the more positive the value is the larger the advantage.
Source: Strydom et al., 2012 a

According to the Coalition Theory mentioned in section 2, everyone in the procurement channel must be satisfied in terms of the purchase agreements and processes. In order to satisfy this theory the advantages must be incorporated/complimented in the procurement contract and the disadvantages must be converted to advantages or excluded from the contract.

In terms of contractual agreements of processors it is also important to identify the target producers, in other words, what type of farm/producers characteristics are appropriate in terms of contractual agreements. Strydom et al. (2012 b) stated that in order to compile a procurement marketing strategy, it is important to know who will participate in a contract governance structure as used by processing companies. The characteristics were determined by using a questionnaire and the data analysis was done with a Principle Component Regression (PCR) combined with a Logit model. Shimi (2010) also used the same analysis in his study. The following characteristics were identified ranked from most important to least important according to probabilities with a minimum of 10% probability:

Table 2. Characteristics of contract potato producers

Variables	Probabilities
Produce at minimum risk	0.0166
Wants to obtain a minimum price (certainty)	0.019
Prefer channel with less marketing cost	0.0211
Wants a channel with a small negotiation period	0.0242
Wants to have less quality penalties	0.0353
Wants to obtain more market information	0.0478
Do not want to make use of own transport	0.0625
Only marketing channel available without additional on farm investment	0.0712
Frequency of contacts between buyer and producer must be smaller	0.0755

Source: Strydom, 2012b

All of the abovementioned characteristics can be used in order to establish procurement marketing strategies and to improve the current contracts. These characteristics are not only the identification of a target market, but it is also an identification of certain features that can be used as motivation within the procurement marketing plan. Processing companies can use these characteristics in order to determine/approach possible new producers.

3.2. Transaction costs

The potato industry is divided into two main marketing channels, namely: Table potatoes and processing potatoes. These two channels have different production and marketing processes after the harvesting of potatoes, creating a difference in transaction costs.

Strydom et al. (2012 c) calculated the magnitude of transaction costs for both of the abovementioned marketing channels. The following were evaluated: different attributes of transaction costs, namely: physical asset specificy, human asset specificy, uncertainty, frequency as well as other proxies that represent transaction costs. All of these attributes had a transaction cost with a statistical significant difference except for human asset specific.

Overall the contract market had the lowest transaction costs in terms of these attributes; however, there were some attributes where the spot market had lower costs than the contract market.

It was concluded that the spot market has the highest transaction costs, which makes the contract market the transaction cost-minimising governance structure. This was also proved by Jordaan (2010) and Milagrosa (2007). The transaction costs were determined for the producers, thus, what is the producers' transaction costs in terms of different marketing channels? This is very important in terms of marketing procurement as explained by Koppelman (2003) in Figure 1. However, it is important to mention that the processing industry have high transaction costs in certain categories. This gives an opportunity to processing companies to evaluate these high transaction costs and then to decrease it with new strategies.

3.3. Profit margins

It is imperative that producers evaluate which marketing channel provides the best profit margins. This forms part of the producers' requirements within the Koppelman (1998) procurement theory. According to Strydom and Grové (2012) it is difficult to compare the two channels, mainly due to the fact that the production process of the two channels differs. If the additional costs, namely packaging and marketing costs, are converted to the same basis, the processing potatoes realize a higher price for the producers than the table potatoes.

The table potato cultivars also have a higher yield than the processing cultivars. In order to compare the two channels one must first calculate the Gross Production Value (GPV). The GPV[1] is calculated according to a yield of 42 tons/ha for processing potatoes and 50 tons/ha for table potatoes. In order to make it easier to choose between the two channels a Cumulative Distribution Function of the historic GPV's of five years for both channels were calculated and illustrated in a graph.

According to the CDF calculated in Figure 2 the processing potatoes has an 86% chance of obtaining a higher GPV over the period analyzed than table potatoes up to a benchmark of R82 000/ha. The GPV is used as a measure of profit margin due to the fact that all other costs for both the marketing channels are the same and this means that the GPV will be the determining factor in terms of profit.

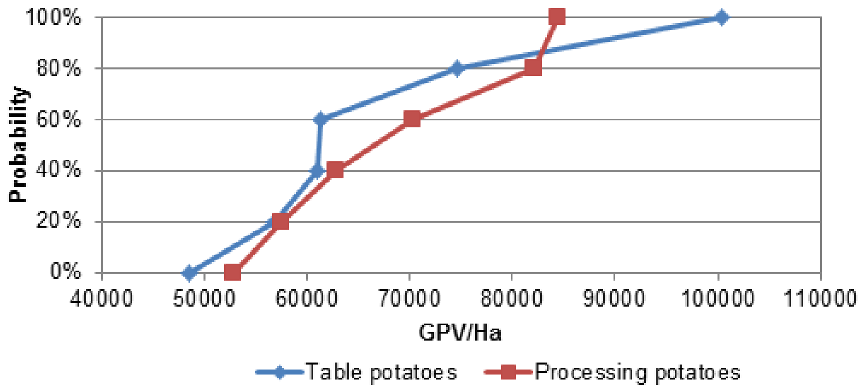

Figure 2. Cumilative Distribution Function of GPV for table and processing potatoes (2005-2010)
Source: Strydom and Grove, 2012

[1] Production costs of both channels are the same value

3.4. Price risk

According to Malan, Louw and Blignaut (2010) effective budgeting and financial bookkeeping are not the only requirements of managing a profitable agricultural business. Agriculture is a high risk business and the decision environment changes on a daily basis. This is why risk management is extremely important to producers.

According to Strydom and Grové (2012) in terms of production risk between the two channels, the risk is the same for both. Both channels are potatoes and both need the same growing standards (moisture, heat units etc.). However, in terms of price risk there are large differences. The table potato market is subject to a spot market, meaning high variability in prices as mentioned earlier, whereas the processing industry has a fixed price contract with possible price deduction.

This is important to contract producers as they do not want a maximum price with deduction for quality, sizes, etc. They want a minimum price with possible price premiums for quality as confirmed by studies. In terms of obtaining the best prices over time, the CDF is used as explained in Figure 2 with processing potatoes having the highest probability of obtaining higher prices. The question remains: what must the producers' yield difference be between table potatoes and processing potatoes given the price risk and producers' risk aversion levels, in order to justify the producers' risk appetite?

Strydom and Grové (2012) determined this by means of calculating a utility weighted break-even, given a scenario of 42 ton/ha for processing and 50 tons/ha for table potatoes. The utility weighted break-even indicated that neutral risk-averse producers must at least produce 41.25 tons/ha in order to justify processing potato production instead of table potatoes; whereas highly risk-averse producers must at least produce 39.4 tons/ha. The differences in yield range from 8.7 up to 10.7 for a risk-averse producer. This will give the producer an indication of target yields according to the producers' risk-aversion levels.

4. Procurement marketing framework

4.1 Transaction costs

Figure 3 is a graphical explanation of the procurement marketing framework in terms of transaction costs. Each type of transaction cost is evaluated by means of giving it a current (Status Quo) rating. This rating ranges from 1 -10 with 1 = very poor and 10 = very good, relevant to the table potato market. Also included into the framework is relative importance (%) ranging from 0% to 100%, with 0% = not important and 100% = very important. This indicates, in terms of the processing companies overall objectives, how important is this specific attribute. The relative weight is then calculated by means of multiplying the importance with the current rating. The relative weights of all the transaction costs must add up to 100%. With the evaluation of the example it is clear that there is a need to re-evaluate the procurement strategies that influence the following: Uncertainty, Other (negotiation) and Human specificy.

The next indicator is the overall weight of the specific procurement framework, which is a sum of all the indexes within transaction costs. This index will be used in the main framework (as discussed later in the paper).

After the quantifying of the framework, strategies must be developed in order to improve the specific framework. However, it is important to mention that the processing industry also has high transaction costs in certain categories. This gives an opportunity to processing companies to identify and evaluate these high transaction costs and then to decrease it with new strategies. New incentives are needed in

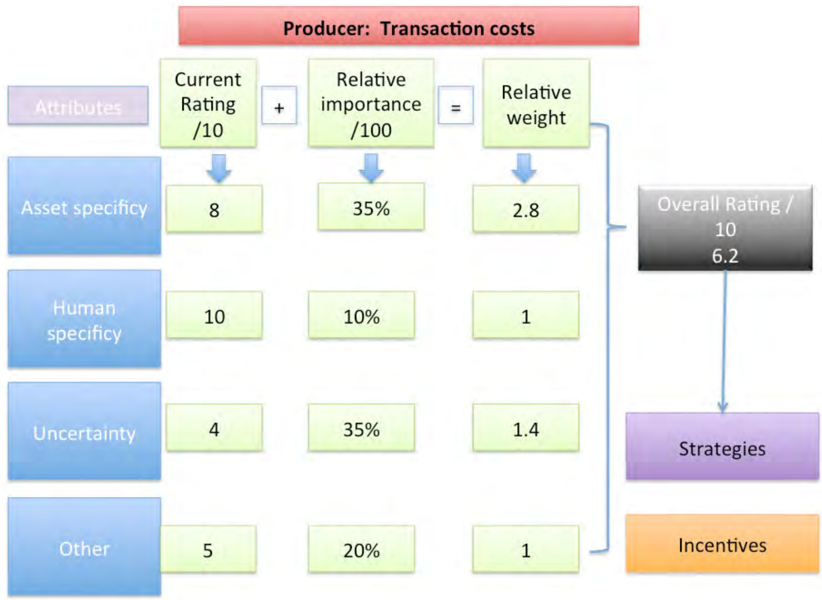

Figure 3. Procurement marketing framework – Transaction costs

order to facilitate the negotiating process. Furthermore, uncertainty also poses a problem: this must be corrected by means of re-evaluating the contractual agreements and as stated previously, provide producers with a minimum price with premium options and not maximum price with deductions.

To summarize this, the following strategies must be used:

- Incentives: Develop a price-setting model that reduces negotiating time and reduces uncertainties. Within this model risk probabilities can be calculated (not covering direct allocatable costs), and the change in risk probabilities due to a change in quality premiums. This means that the price-setting model reduces negotiating time and reduces uncertainty regarding price premiums and probabilities.
- The forming of alliances between producers (group negotiating) can assist producers with the negotiating process. However, this must be done according to the rules and regulations of the Competition Commission Act.
- The processing company must start with a marketing campaign emphasising the low transaction costs of producing potatoes for processing and with this strategy attract new producers.

4.2. Profit margins

Figure 4 explains the procurement marketing framework in terms of profit margins for producers. The same methodology as with the transaction costs was used in order to set up a framework. The price structure received a relative weight of 3 and the profit margins a relative weight of 3.5, both of these sub-headings need some improvements.

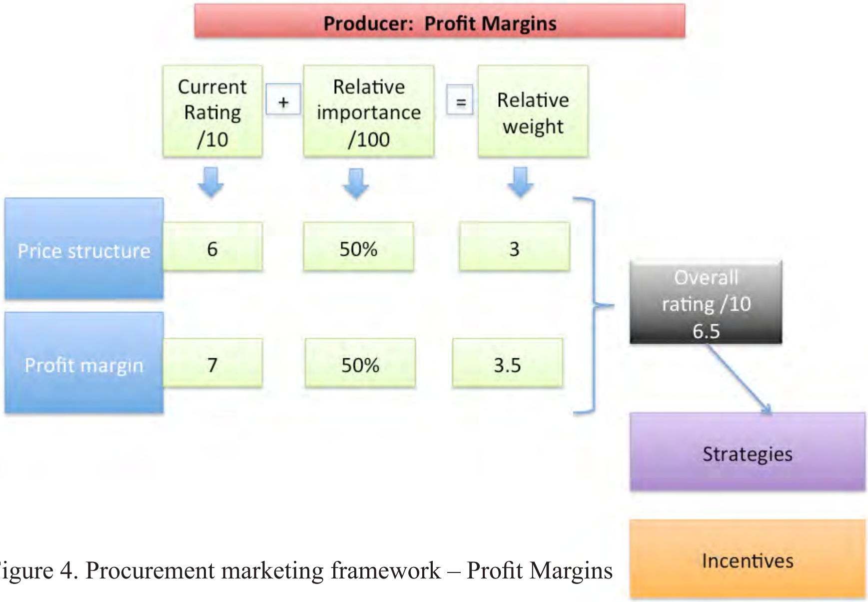

Figure 4. Procurement marketing framework – Profit Margins

- Develop a decision-support model: within this model the producers can compare the two channels profit margins according to the producers' specific conditions and risk appetite. This will assist the producers with the decision- making regarding the different marketing channels and it will also assist the processing company with the procurement marketing and price negotiation and contracting.
- In terms of strategies, the processing companies can make use of price premiums in the contract and not deductions, to attract new producers.
- The processing companies already provide the farmers with better seed prices, meaning the processing company buys the right quality seed in bulk and sell it to the different producers at a discounted price. The processing companies can examine the possibility to applying this method to other inputs such as fertilizers and chemicals.

4.3. Price risk

The price risk framework was based on price volatility and price comparisons between the different marketing channels. In terms of price volatility the table potatoes have a high volatility whereas the processing industry does not have a quantifiable volatility (Du Preez and Van Zyl, 2010, Du Preez and Grové 2011, Strydom and Grové, 2012). However, there are small changes in prices due to quality penalties within contract prices. Within the framework there exists a need to evaluate the price volatility. This example clearly explains the relevance of the framework. If the industry were evaluated in terms of price risk, the conclusion would have been that the industry is better off than table potatoes in terms of price volatility; due to the fact that it makes use of a purchase contract, which is a fixed price mechanism and not subject to spot price movements. However, this is untrue due to the fact that quality penalties are one of the reasons for increasing transaction costs (Strydom et al. 2012 c).

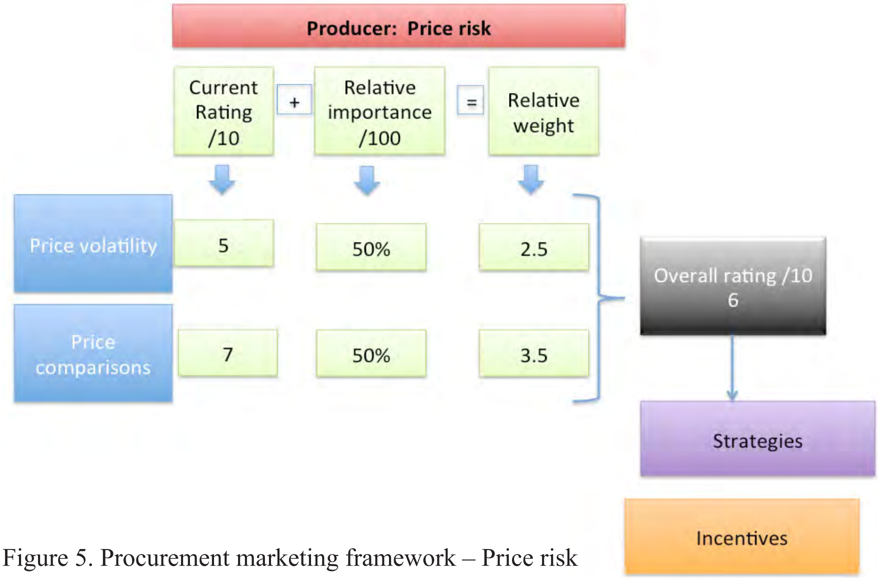

Figure 5. Procurement marketing framework – Price risk

- In terms of incentives, a Decision Support Model (DSM) can be used as explained previously. This DSM calculates the probability of the processing industry obtaining higher prices as well as the break-even utility for various risk-aversion levels. Not only does it assist the producers with their decision- making; it also reduces their transaction costs in terms of negotiating, marketing time and uncertainty.
- Processing companies can use the DSM as an assisting tool for producers and to form part of the negotiating process. The DSM can also be used as a marketing initiative, indicating to producers the benefits of producing processing potatoes.
- The utility break-even yields will also assist processing companies in explaining the differences in yields. For example: The yield difference can be up to 10.7 ton/ha and it will still be worthwhile for a risk-averse person to produce processing potatoes.

4.4. Proposed procurement marketing framework

After the completion of the elements of the main framework the framework itself can be completed. The main framework makes use of the same methodology as the previous evaluated frameworks (4.1 - 4.3); however, within the main proposed framework there is a purchase agreement focus (contract) as well. In this framework it is clear that much of the procurement marketing focus must be on the benefits of profit margins (index of 2.6). The other two pillars however, namely transaction costs and price risk, must improve in order to gain importance. The strategies and incentives of the previous framework must be combined into a procurement marketing strategy. The importance of the main framework is in the purchase agreements (contracts) since this is the chosen governance structure used by processing companies and serves as the link between producers and processing companies.

The strategies decided on must reflect the needs of the producers. This is why it is important to evaluate the target market (contract producers). If the processing companies know the characteristics of the contract producers they can develop their contracts according to the needs of the

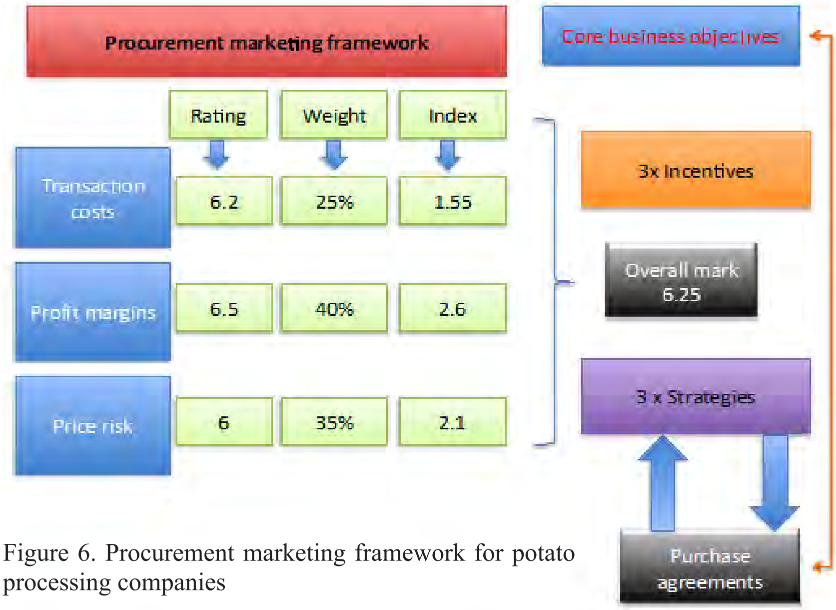

Figure 6. Procurement marketing framework for potato processing companies

company and the producers. It is also important to keep in mind that the strategies must satisfy the contract specification, but vice versa, the contract must also facilitate new strategies.

It is essential to keep in mind that the procurement marketing process is not all about the producers; the processing company also have certain core business objectives that must be satisfied. This means that the business objectives must be in line with the contractual agreements and the strategies developed.

In terms of the purchase agreements the following strategies/adjustments are recommended:

- Employ a third party grading company outside the processing company to create trust in grading and which will determine the price premiums. The producers as well as the processing company must then pay this grading company on a 50/50 basis. This is mainly done to share the advantage and to build trust.
- Another strategy can be to obtain a second opinion. If a producer's freight is rejected, a sample of the freight must be couriered to an independent grader in order to confirm the results. If the results are the same and the load is rejected, then the producer can pay the costs associated with this second opinion. This method can lead to a hold-up of a minimum of three hours, since the sample must be couriered. In the transaction cost section, contact and negotiation were identified as low transaction costs; such a strategy can increase some of the transaction costs; however, it could also reduce the uncertainty attribute of transaction costs.
- Another step will be for the processing companies to be more informative on their grading procedures. Processing companies, most of the time, have measures in place to ensure that there is no above-normal variation in the grading of a producer's product. The producers do not know of these procedures and must be informed. All of the abovementioned factors will increase trust. This will also satisfy the characteristic of market information and reduces the uncertainty attribute in terms of transaction costs.

- In terms of long-term contracts with producers experiencing quality problems, the processing plant must attempt to find an alternative use for these potatoes instead of rejecting it. This can be in the form of using it; if not for frozen fries but then as potato pieces in one of their other products, such as mixed vegetables or wedges.

The cultivar specification mentioned by Strydom *et al.* (2012 a) can be a problem, for the reason that some of the less preferred cultivars by processing companies are highly related to the fresh produce market (for example Up-to-date). Two scenarios can be examined:

Scenario 1 – *High prices in the table potato market (at the time of harvesting) relative to processing contract prices, and the producer planted a multi cultivar such, as Up-to-date.*

Since the producer has already signed a contract, the producer cannot benefit from these high prices in the fresh market. Thus producers will try to get the contract terminated, which creates a procurement risk for processing companies.

- Processing companies can structure minimum price contracts implying that the price can increase as the fresh produce market price increase. This implies that the processing company can make use of a formula price setting model (Rhodes *et al.* 2007). Thus, if a producer delivers the produce; the producer receives the fresh produce market price, calculated relative to the processing industry. The problem is that it increases the risks of the processing company, such as price risk and variability. In order to do this, processing companies must only implement this strategy with long-term contracts.

Scenario 2 – *The prices at the fresh produce market is not that high and a producer planted a cultivar only used in the processing industry.*

If the producer has grading problems and the potato load is rejected by the processor, then the producer must sell the potatoes on the fresh produce market, which is the alternative market. The specific cultivar is not that popular in the fresh produce market, resulting in an unattractive price to producers, along with the costs such as bagging and transport (mostly on contract bases). If the producer planted the multi cultivar, the risk will be much lower due to the higher popularity.

- If processors want to establish long-term contracts they must prevent/decrease these risks for the producer. If producers have grading difficulties with their produce the processing company must try to use the potatoes and not just reject the freight on delivery at the plant as explained previously.
  - In terms of the negotiation of contracts, it is suggested that processing companies use the example of the USA as explained by Larson (2009), namely to establish a farmer producers' association that elects a president representing them who negotiates prices with the processors. This will decrease transaction cost in terms of negotiation.
  - In terms of procurement marketing the processing companies must evaluate the disadvantages and make use of the abovementioned strategies in order to enhance contracting, which will have a direct effect on the procurement marketing.

5. Conclusions

The potato industry in South Africa is important to the agricultural processing sector. The last decade saw a substantial increase in the volume of potatoes that was processed into frozen fries – from 70 000 tons in 1997 to 170 000 tons in 2007, which reflects a growth of 143% (Potato SA, 2009). Thus, frozen fries are becoming increasingly important as a final product within the potato industry of South Africa. South African potato producers have two main marketing channels. Firstly, the normal fresh market which is defined as the spot market. The second channel is the processing market, which can be divided into two sub-sectors, namely frozen fries and crisps. This channel is known as the contract market.

The problem is that processing companies do not get enough potatoes from producers in order to satisfy the demand for the final product. This means that procurement marketing (backwards marketing) is struggling. In agri-business procurement marketing is extremely important, mainly because if the company does not receive the raw material (commodities) it cannot produce the final product and run the processing plant at optimizing levels.

In an agricultural environment procurement marketing is based on four pillars: transaction costs, risk, profit margins and contractual agreements. These four variables are the most important variables when producers choose between two marketing channels. The question is: how do the two channels compare regarding each variable from the perspective of producers and what possible strategies can be developed from these variables in order to compile a procurement framework for processors?

The procurement marketing framework assists processing companies with these answers; the companies can also on a regular basis evaluate the current state of business according to the framework. The processing companies must make use of the incentives (models) created in order to launch marketing campaigns for procurement contracts of potatoes. These incentives must also be used in order to satisfy strategies and targets set out in the framework. They can also make use of the framework developed in this research, as a blueprint for developing a marketing procurement plan. The framework has various advantages, amongst others:

- Better quantification of focus areas,
- Set of guidelines to assist with strategy formulation and strategy revaluation,
- Efficient tool to capture progress on procurement marketing,
- Flexible in terms of developing new incentives and strategies,
- Alignment of producers and processing company objectives.

However, it is important to keep in mind that the processing company has certain core business objectives that must be satisfied as well. The framework with the strategies must be in line with the core business objectives. The framework will also only be successful with proper research and an efficient implementation plan. The implementation plan must have targets, objectives and evaluations that is measurable. Thus, there is a need for a proper developed implementation plan for this specific framework.

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AGRICULTURAL POLICY IMPLEMENTATION: INTRODUCING REAL-LIFE COMPLEXITY

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Abstract

The paper deconstructs the commonly used terms "state" and "agriculture" at a provincial level and dwell on the concept of the rational civil servant. In the case of state the challenge of moving beyond institutionalised silos are discussed. It was shown that agriculture consists out a multitude of actors, that representation often overlap and that similarities with a "tragedy of the commons" can be observed in the way some of the actors maximise personal gains. To understand the system non-traditional schools of thought such as Social Economic Systems and Bounded Rationality may provide answers.

Keywords: agricultural policy, South Africa

1. Introduction

During policy development and in the policy debate terms such as "state" or "agriculture" are usually used without any attempt being made to understand the intricacies embedded in these terms. Yet, in the final instance it is usually people who have to take responsibility for implementation of policies or who are recipients of policy measures. For this reason this paper will, with the Western Cape Province[1] of South Africa as a case study, deconstruct the concepts of "state", "civil servant" and "agriculture" before a new approach to cope with policy change is recommended.

2. Deconstructing the "State"

The South African Constitution (Act 108, 1996) establishes three distinct spheres of government, each with its own responsibilities and powers. However, the Constitution also indicates particular areas excluded from the mandates of particular spheres of government. The Public Finance Management Act (Act 1, 1999) further establishes an Accounting Officer in each organ of state (usually the Head of Department) who is responsible for all income and expenditure in the particular government entity. Although this is a very progressive public governance stance, in practice it leads to the situation represented in Figure 1.

National government consists of a number of departments and statutory bodies. These agents of state usually have offices or branches geographically located in the area of responsibility of provinces. At the same time some tertiary institutions, although established under national legislation, is also situated in one or more province with an associated provincial footprint. Provinces, being a distinctive sphere of government, have their own range of organs of state (departments and statutory bodies) accountable only to the Provincial Parliament. At local level, still within the geographical area of provinces, the three types of municipalities (local, district and metro/city) have their own set of functions, responsibilities and lines of accountability.

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1 The Western Cape is one of nine Provinces of South Africa. This Province, at the South-Western tip of Africa, is responsible for 21% of South Africa's agricultural production and 45% of the country's agricultural exports.

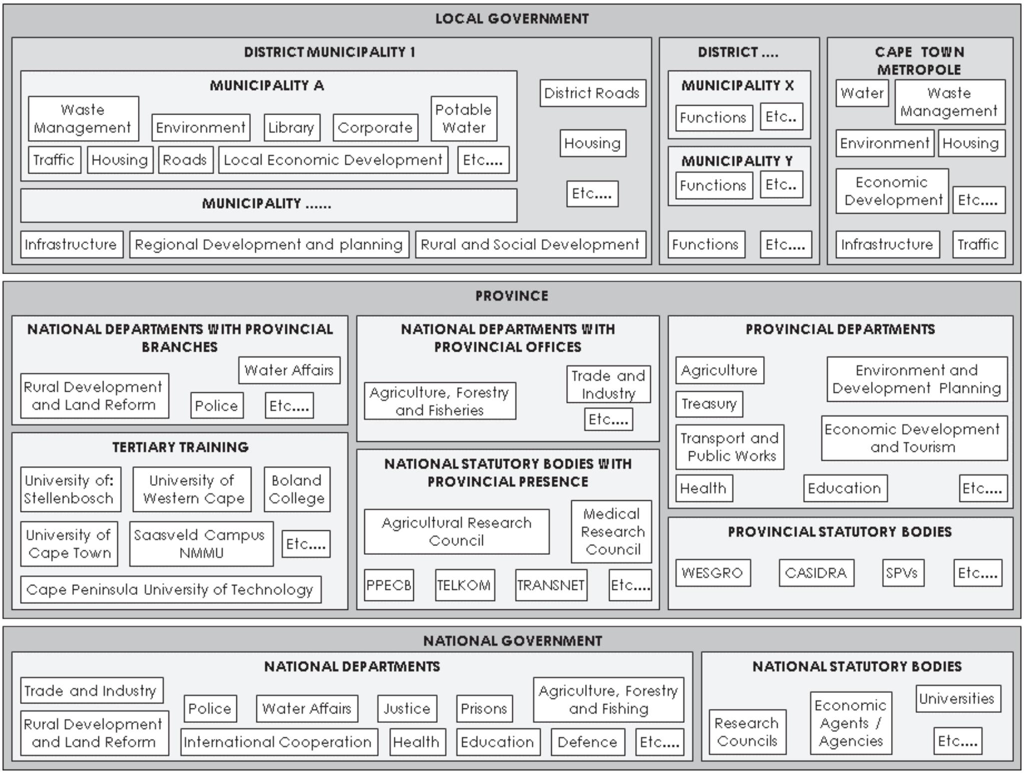

Figure 1. Schematic representation of institutionalised silos in government
Source: Troskie, 2013

This complexity can partially be described from the viewpoint of a hypothetical smallholder farmer. This farmer received a land reform farm from the (national) Department of Rural Development and Land Reform and an operational loan from the (national) Land Bank. Infrastructure needs gets funded via the Comprehensive Agricultural Support Programme (CASP) which is a programme of the (national) Department of Agriculture and implemented by provincial departments of agriculture. However, to build a shed he must get approval from the local municipality which will grand approval according to guidelines developed at provincial level at the hand of prescripts provided by national legislation. Additional water, a prerequisite for successful farming in most areas of South Africa, is a competency of the (national) Department of Water Affairs. Before he can export his apples he needs inspection from the (national) Perishable Products Export Control Board (PPECB), but the export of animal products needs to be licensed by the (provincial) veterinary services. His products not making the grade for export will be sold at local (municipal) markets.

Given this complexity a large number of (unschooled) smallholder farmers struggle to access the range of services available to them. The same principles apply to other agricultural activities such as research, protection of the natural environment, training, exports, etc. With the wide range of actors from different spheres of government having a stake in agriculture, it is often easier to develop consensus on agricultural matters with private sector players than between organs of state.

Each organ of state consists out of human beings with all the strengths and weaknesses associated with humans. De Gorter and Tsur (1991) introduces the “rent maximising bureaucrat” arguing that the typical bureaucrat will maximise his / her own utility and that this will inevitably add to the welfare of society. Normally a redistributional effect is postulated; implying that patronage to a particular group must be offset by payments from another part of society. Due to the South African Constitution's limitations on the revenue generating powers of provinces, this "reality check" is absent with the result that utility (power) will be increased by maximising the size of the structure, the number of employees and hence the budget controlled. If this argument is related back to the way provinces are funded (and the emphasis placed on needs rather than results), one can argue that a perverse incentive for non-performance has been built into the system.

Fortunately, one the fathers of rational decision making (Downs) had a more diverse view of the objectives of bureaucrats. He makes a distinction between "self interest" and "mixed motive" officials. In the case of self interest, the following categories emerge:

- Climbers: These are officials purely seeking to maximise their own utility (as it may be embodied in power, income or prestige. Thus, they either seek to win promotion, aggrandize their current position or to build their reputation in order to find a better job elsewhere.
- Conservers: People seeking to maximise their own security and convenience. Security is equated to the status quo and for this reason they will oppose all change, and innovation.

For mixed motive officials three categories are described:

- Zealots: Persons loyal to a relatively narrow policies or concepts. They seek power both for its own sake and to implement the policy options they are proposing.
- Advocates: This group is loyal to a wider set of policies or to a broader organisation. They are impartial to the merits within the organisation or framework to which they are loyal, but highly partisan against outsiders.
- Statesmen: Officials loyal to the nation or society as a whole and, to a certain extent, the type of official idealised in most textbooks. However, as they enjoy influencing important decisions, they still seek to enhance their power and prestige for personal and altruistic reasons (Downs, 1964).

It follows that there is more than one way of approaching the concept of state and Hill (2009) provides a useful classification:

- A passive entity to be influenced / captured (Pluralist and Marxist view)
- An active entity with interests of its own (Elitist, Corporatist and public choice theories).
- Containing actors with potentially conflicting interests (Policy Network / Community).
- A structured system influencing and constraining action (Institutional theory)

3. Mind-games in South African agriculture: a tragedy of the commons

As is the case with "state", "agriculture" is actually a collective noun for a range of (conflicting) actors. Indeed, South African examples can be provided where one segment of the Sector actively (domestically and internationally) undermine the economic wellbeing of the whole in order to secure particular short term gains. Examples include articles appearing in the Danish consumer publication Taenk (Taenk, 2009) and the Austrian consumer journal Konsument (2009) articulating a particular viewpoint regarding evictions and farm workers as "slaves". It is evident that this leads to international consumer resistance (see for instance Heizer & Heizer, 2009) against South African Agricultural products resembling marketing conditions during the Apartheid (sanctions) era. This extraction of individual rents from a system and thus swaying the sentiment in the system is equated by Hassan and Mertens (2011) to the tragedy of the commons.

In the paper originally coining the phrase "tragedy of the commons" Hardin (1968) departs from the (mathematically correct) tenet that it is not possible to maximise for two (or more) variables at the same time. He sketch the scenario of a herdsman on common grazing area (at its maximum carrying capacity) making the decision whether to add another cow to his flock. This cow will have both a positive (income for the herdsman) and negative (pushing the commons into being overgrazed) impact. The positive impact will be close to one on the herdsman's personal utility, but the negative impact will be shared between all the herdsmen. When this herdsman adds the positive (approaching one) and negative (approaching zero) utilities, the rational choice would be to add another animal to his herd. This would also be the rational choice (for himself and all the other commonage users) in adding a second, third and fourth animal. According to Hardin's reasoning it is inevitable that a common property would lead to its over-utilization.

The nature of the scientific process is that the underlying assumptions and conclusions of any approach will be questioned (after all, to publish in peer reviewed journals academia must engage theory and develop critique). In the case of the tragedy of the commons the critique contains elements such as the fact that not all actors are exclusively motivated by short term gains. Furthermore, as not all individuals are identical nor firms homogeneous, actors are not summarily interchangeable and there may be existing (formal or informal) rules of access to the commons or usage of its resources (Al-Fattal, 2009).

What is the nature of this commonage of the mind in the case of one of the provinces of South Africa? There are currently approximately 6 653 commercial farming units in the Western Cape Province and, including farm owners, there are between 123 000 and 201 230 persons directly

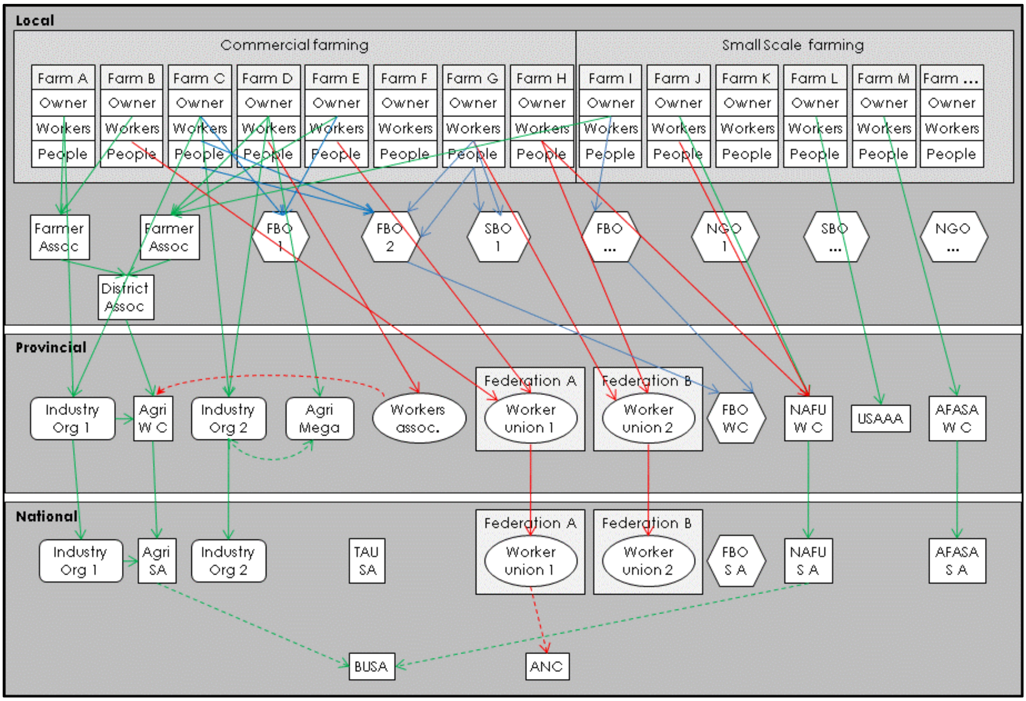

Figure 2. A schematic representation of some of the actors in the Western Cape Agricultural Sector
Source: Troskie, 2013

involved in farming. There are also about 9 844 smallholder farmers who employs a further 6 455 people as farm workers (WC, 2010). It can be postulated that the average person employed in farming supports four other people (family members, pensioners, acquaintances and the children of others). Thus, roughly 700 000 people, out of a provincial population of 5,8 million, lives on farms.

The people living on Western Cape farms can be grouped into three broad categories (see Figure 2):

- The owner of the farm or, in the cases of absentee owners, the most senior manager.
- Farm workers. Although some live in towns or "agri-villages" and commute on a daily basis to the place of work, by far the greater majority still lives on the farm.
- Other people living on the farm. In a number of instances these people are not necessarily working on the farm.

The majority of commercial farmers belong to a farmer's associations or industry organisation which jointly forms Agri West Cape and eventually Agri South Africa. However, in some instances certain industry organisations are loosening its ties with the Agri West Cape structures and are finding alternative administrative homes in organisations such as Agri Mega. Although there is currently no credible alternative structure representing commercial farmers in the Western Cape, an alternative (TAU SA) does exist at national level and is attempting to expand into the Western Cape. This association has politically more conservative objectives and is increasingly becoming involved in non-agricultural issues (joining forces with organisations such as AfriForum and Solidariteit). This threat, of TAU eroding their membership, is in itself sufficient enough to have an influence on the actions of Agri Wes Cape.

There are currently three organisations representing smallholder farmers in the Province. The first is the Western Cape Branch of the National African Farmers Association (NAFU). On the verge of being defunct, attempts were made in 2010 to "re-launch" it. However, as the incumbent management of NAFU threatened to take the "new" management to court, the latter established a separate organisation with the name of African Farmers Association of South Africa (AFASA). The third organisation, United South African Agricultural Association (USAAA) is predominantly a Western Cape based organisation.

Within and between these five organisations (whose actual paid-up membership remains a secret) there are often differences of opinion and personality clashes. Organisations representing the interests of farm workers and rural dwellers are even in a worse disarray of diversity. A number of labour unions and worker organisations represent some of the farm workers as well as workers in associated industries (e.g. canning, transport, etc.). A number of these labour unions (e.g. Food and Allied Workers Union (FAWU)), are affiliated to the Congress of South African Trade Unions (COSATU). Other worker federations with agricultural related affiliated unions include the Federation of Unions of South Africa (FEDUSA) and the National Council of Trade Unions (NACTU). Nevertheless, most farm workers in South Africa remains un-unionised.

An even wider range of organisations maintain that they speak on behalf of the people living on farms and, sometimes, also on behalf of farm workers. This range of organisations include faith based organisations (FBO), community based organisations (CBO) and other non-governmental organisations (NGO). Most of these organisations are dependent on donor money and their activities range from specific or general advocacy of real or perceived challenges faced by people living on farms (e.g. Women on Farms) to addressing particular concerns (e.g. Foetal Alcohol Syndrome).

In an interesting South African twist COSATU (and thus FAWU) is also part of the Tri-Partite alliance, with the African National Congress (ANC) and the South African Communist Party

(SACP), governing South Africa at national level as well as in eight of the nine provinces. Another tweak on the same vein is that the Western Cape Branch of NAFU claim that they do not only represents small scale farmers, but also "...other vulnerable groups such as youth, women, people living with disabilities, and farm workers…" (NAFU WC, 2011). This provides a new dimension to arguments regarding elitism and the relationship between labour and capital.

4. From tragedy to common

It is clear that (agricultural) state and society are both fragmented and consist out of individuals with the incentive to influence the collective leading to a need to explore alternative literature. The "tragedy of the commons" theme leads us to explore Social Ecological Systems (SES) and the writings of one of its best known experts, Nobel Laureate Elinor Ostrom. In an overview paper Ostrom (2008) suggests that the following principles should be considered when designing governing systems for sustainable common resource use:

- Accurate and relevant information. The system as well as the individuals involved in it changes over time with the result that reliable current information is required.
- Clearly defined boundaries. The boundaries of the system should be clearly defined as well as the rules specifying who (and their entitlements) forms part of the system.
- Collective choice arrangements. Those affected by the outcome should be involved in the processes.
- Deal with conflict. Those involved in the common system should have rapid access to low-cost, local arenas to resolve conflict among actors.
- Graduated sanctions. Actors who violate rules are to receive graduated sanctions (depending on the seriousness and context of the offense).

A second model to explore captures both individual and collective (system) choice during the process of policy decisions (see Figure 3). At the core of this model is the identification of the issues to be addressed. As organisational agendas are usually indicative of individual's priorities and the attention scope of both individuals and organisations are limited, some form of prioritisation needs to take place. The priorities are often not the result of informed reasoning, but rather emotional responses to (political?) problems resulting in high priority issues receiving the brunt of attention whilst less important concerns may fall along the wayside. Alternatively, the latter may follow the route of incrementalism or may receive "pre-packaged" solutions.

There is a logical relationship between organisations and its members. People will withdraw their membership or become inactive members if organisations regularly ignore the issues that its members perceive to be the most important. Conversely put, in an environment with abundant issues and a range of organisations reflecting those concerns, individuals will become members of those organisations reflecting their personal view of what is important creating an "idea marketplace".

Once the organisation's agenda is determined, it is followed by the characterisation of the problem (at individual level) and defining the problem (at organisational level). However, the information that people receive is rarely neutral and it has already been argued that context has a major impact on people's reaction resulting in problem contextualisation remaining an extremely important area in the policy process.

Given the way the problem is defined, a number of alternative ways of solving the problem may be identified. As each individual will have at least one alternative solution in mind, it follows that a process (structured or unstructured) usually takes place at organisational level to determine a potential range of solutions. This range of solutions then eventually needs to lead to a policy choice.

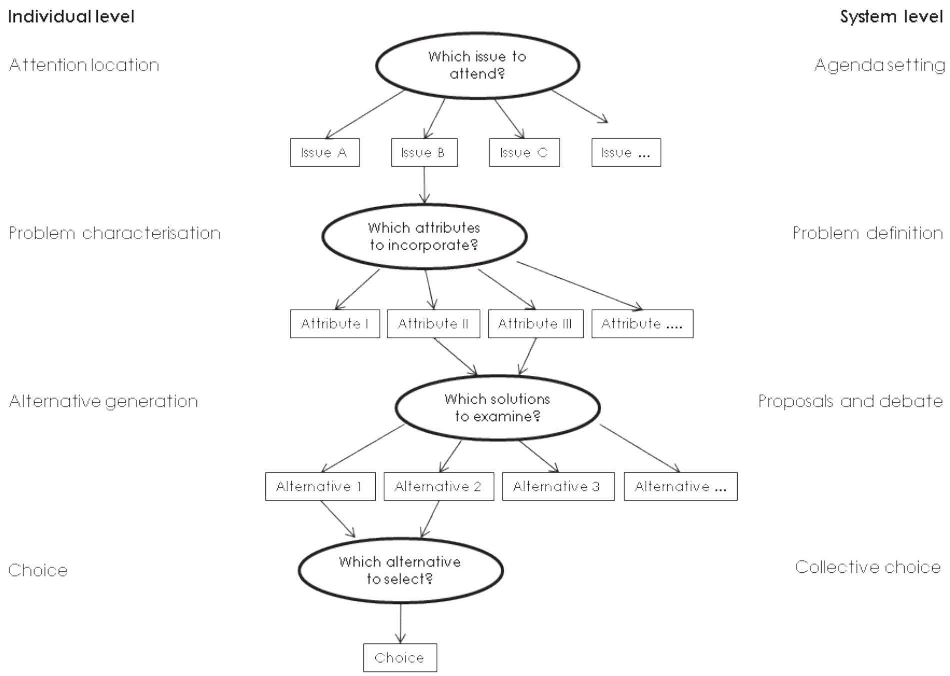

Figure 3. An information processing model of choice
Source: Jones et al, 2010

Although this model represents reality in a logical way, reality is seldom neat. Real world processes may be incoherent, intermittent and dependant on the nature and severity of exogenous shocks of the day. The various phases usually get intertwined and individuals often identify a preferred solution even before they identify the issue at stake. Jones *et al* (2010) calls this phenomenon "identification with the means". It follows that people's emotional orientation towards a specific solution (or political ideology) often determines the alternatives to be considered with the result that people will be very hesitant to accept certain information elements. Or, in the aphorism often used, if a person only has a hammer, everything becomes a nail.

During a recent research project Bonneau (2012) interviewed 27 organisations in the Western Cape. These organisations covered the whole spectrum from farming unions (including Agri Wes Cape, Agri Mega, NAFU, industry organisations), trade unions (BAWSI, FAWU, Sikhula Sonke, Prestige Farm Worker Council), non-governmental organisations (SANCO, Surplus People's Project, Women on Farms) to institutional organisations such as government departments and academic institutions (e.g. PLAAS). During these interviews a number of sensitive issues such as housing, evictions, socio-economic conditions on farms, access to land and farm tenure were mentioned by all. Nevertheless, he also found that all agreed on certain commonalities such as research, training and capacity building for workers and for farmers, education as well as social upliftment on farms. These commonalities may form the foundation to address the sensitive issues.

5. Conclusions

Policies are quite often developed for an idealised construct of "state" and "society". With the aid of a case study it was argued in this paper that "state" not only consists out of various organs, but that individuals with their own objectives and humanness plays a determining role in each of these entities. A similar argument can be made regarding "agriculture" with the result that the emotional space of agriculture can sometimes be equated to the Tragedy of the Commons where short-term individual rent extraction may jeopardise the long-term sustainability of the whole.

In moving beyond tragedy it is important to create the right institutional environment and Social Ecological Systems may provide some pointers. At the same time it is also important to recognise that an interactive relationship exists between individual and system priorities and that provision should be made in policy planning and implementation for this process to develop.

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BASIC ROUTINE SOURCING STRATEGIES FOR PRICE HEDGING OF WHITE MAIZE IN SOUTH AFRICA

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Abstract

Maize Milling firms use complex procurement strategies to procure their raw materials which include price hedging strategies. In this, study basic routine price hedging strategies were analysed as part of the procurement of white maize over a ten year period ranging from 2002-2012. Part of the pricing strategies used to procure white maize over the period of ten years were a call and collar strategy. These strategies were compared to the baseline futures (spot) market. The data was obtained from the Johannesburg Stock Exchange's Agricultural Products Division better known as SAFEX. The data was analysed by using descriptive statistics and a Cumulative Distribution Function. However these routine price hedging strategies were used, by using the real (Not taking inflation into account) costs incurred were over the ten year,period is also revealed in the paper for implementation in each of the strategies. The results obtained from the study prove that by using basic routine price hedging strategies to procure white maize, it is more beneficial to do so then by procuring from the future (spot) market. Thus it can be concluded that it is not necessary to use a complex method of sourcing white maize through SAFEX, to be efficient, by implementing a basic routine price hedging strategy year on year it can be better than procuring from the futures (spot) market.

Keywords: b-asic routine procurement strategies, CDF

1. Introduction

Maize is the most important grain crop in South Africa, being both a major feed grain and the staple food for the majority of the South African population. About 60% of maize produced in South Africa is white maize and the other 40% yellow maize. Yellow maize is used for feed requirements and white maize primarily for human consumption. White maize meal plays an integral part in the diet of the poor in South Africa and accounts for 94% of consumption in the African continent. Taking these facts into consideration it is essential for millers, processors and grain pricing firms to make use of procurement strategies in order to procure raw materials at the lowest possible price and to do it in a predictable and reliable manner to ensure more efficient contracting with buyers of the processed product. Thus, risk and price risk management is a critical function in the operations of the agribusiness, whether they are involved in production, processing or trading activities. Price risk is important, due to the fact that high variability in profits is a result of variability in prices. This paper only focuses on price risk and how to use a standardized approach to price hedging, as part of procurement.

Prior to the deregulation of markets in 1996, grain prices were determined by the Commodity Boards of South Africa and a fixed price was set for the production season. This period of regulation ended with the implementation of the Marketing of Agricultural Products Act of 1996 ordering the demise of most of these control boards. Groenewald, Geldenhuys, Jooste (2003) argues that variability of prices has increased since deregulation. Jordaan & Grové (2007) confirmed the increase of variability means of determining the price volatility of field crops that are traded on the South African Futures Exchange (SAFEX).

The variability in prices does not only influence producers of maize but also the processors or procurers of maize. This highlights the emphasis that farmers and processors must have a mechanism to protect them against unwanted price movements that would lead to financial losses. Several instruments are available for agribusiness firms to manage and reduce their exposure to sources of price risk, in addition to forward contracts, futures and options on futures of maize.

The main objective of this paper is to evaluate basic standardized routine price hedging mechanisms to a baseline where the spot price for white maize is used to procure grain. The secondary objective is to determine what would be the probability of a certain outcome when using a specific strategy; this would be done by using a Cumulative Distribution Function (CDF). When referring to the baseline in this study it is considered to be the spot (futures) market price for white maize, for example it is the physical closing price of the April white maize contract on a specific day and time on SAFEX for the nearest contract. Also when referring to basic standardized routine price hedging mechanisms a call and collar strategy was used to compare against the baseline.

2. Basic routine grain procurement strategies

Effective price risk management strategies as part of procurement can give processors like millers a competitive advantage over rivals and increase the firm's profitability. Conventional alternatives for pricing strategies range from spot purchases, with specifications for easily measurable characteristics to varying forms of strategies with pre-commitment. In the case of grains these choices are complicated by two factors. First there is intrinsic uncertainty associated with end use qualities that are not easily measurable. Second, grain prices and therefor procurement costs vary spatially due to competing market regions (Wilson, Dahl and Johnson, 2000).

Due to the development and organisation of procurement strategies that have escalated in importance with food processing industries, as well as with the prospect of greater choice attributes to development of information (Wilson, Dahl and Johnson, 2000). For the purpose of this research, easy to use routine procurement strategies are identified and evaluated to determine the effect of these routine procurement strategies and to determine if it's more beneficial by using these strategies than buying on the spot market.

2.1. Routine procurement strategies

Strategy Spot: Purchase the crop in the cash market

Strategy spot is used as the baseline strategy and signifies a situation where no active procurement strategy is done. It is assumed that the decision maker buys white maize at the end of each month for twelve month sequence. The strategy is not amended with regards to price management and is only used to make comparisons.

Strategy Call: Buy a call option one year in future

Options are derivative instruments that can be used for price risk management (Hedging) or as a mean of speculation (Johannesburg Stock Exchange, 2010). The holder of an option has the right, but not the obligation to buy or sell an underlying instrument at a pre-determined price during a specific period or at a specific time. Buyers hold the rights, but not the obligations while sellers assume obligations to buy or sell an underlying futures contract if the option is exercised by the buyer (JSE, 2010). A miller or maize processor, who is concerned that the price of maize will rise in the future, will make use of a call option to protect himself against unwanted price movements in an upward direction. Thus a call option is used to manage price risk and to hedge against unwanted price movements in the market. At the expiry date, the miller or processor will have the right to buy the maize at a minimum price which was agreed on at a specific time and date. When the miller or processor exercises this option, he developed protection against rising prices and has the opportunity to benefit from decreasing prices. The negative side of a call strategy is the effect of premium (the cost of taking out the option) that must be paid for purchasing the call strategy.

The data used for the strategies were historical SAFEX prices on the 1st of May for white Maize, an at the money call option was bought and expiry was the last five working days of April, one year in advance. The option cost was calculated by using the Black Scholes Model originally developed by Black Scholes (1973), given the SAFEX – price (at the money) while historical volatilities are obtained from SAFEX. The spot price is the alternative price when the option is not exercised (Spot price + Premium).

Strategy Collar: Buying a call option and put option simultaneously

A collar option strategy, also known as a ‘’hedge wrapper’’ is used to lock in the maximum gain and maximum loss of a stock or commodity. To execute a collar, an investor, miller or processor buys a white maize at-the-money call contract while simultaneously selling an out-of-the-money put option. Thus the miller or processor locks in a floor price and a ceiling price. The collar option is also used to subsidise the call options premium.

The primary benefit of a collar option is to limit downside risk. However, collars also limit profits on the upside. A collar strategy is a conservative strategy that is generally implemented to protect profits or lock in prices, and not generate them. For the purpose of this research an at-the-money call option was purchased and an out-of-the-money put option was purchased simultaneously on the first business day of May with expiry of the option on the fifth last business day of April (May futures contract) one year on.

3. Risk quantification

A non-parametric approach is adopted in this study to quantify a Cumulative Distribution Function (CDF) of white maize prices for the basic routine procurement strategies. According to Goodwin and Mahul (2004) a non-parametric approach is the preferred method of analysis in cases where fewer data points are available, such as the case with this research. Historical data ranging from the year 2002-2012 were obtained from the Agricultural Products Division, better known as SAFEX (SAFEX 2010) on the Johannesburg Stock Exchange’s website this was used to evaluate volatilities, spot and futures contract prices for white maize and also to quantify the price risk associated with each of the basic routine procurement strategies. Resulting price were expressed in 2002 real values, before constructing the CDF, assuming that each year has an equal chance of occurring

4. Results

4.1. Statistical moments of basic routine sourcing price hedging strategies for white maize in South Africa

Statistical measures are used in Table 1, to indicate the variability within basic routine procurement strategies of white maize. These values are expressed in real (taking out the effect of inflation) Rand values.

Table 1. Statistical moments of basic routine sourcing price hedging strategies for white maize in South Africa

	Call	Futures	Collar
Mean (R)	1496	1609	1475
Standard Error (R)	173	159	184
Median (R)	1526	1595	1483
Standard Deviation (R)	548	503	581
Minimum (R)	625	946	554
Maximum (R)	2279	2499	2442

Mean price received: The mean price received from basic routine procurement strategies is the primary indicator of their relative performance. The procurement strategy that returns the lowest mean price compared to another will be the more favourable strategy given price variability is not a concern. In the research, white maize prices were analysed according to their mean price received for each strategy. The lowest mean prices for white maize are as follows, ranging from the lowest to the highest, these values are derived from Table 1:

- Call Strategy,
- Collar Strategy,
- Futures (Spot) Strategy.

The mean prices for both strategies incorporated are lower than that of the Futures (spot) price.

Minimum and Maximum: The minimum and prices indicate the low/high range of the procurement strategy outcomes over the period of 2002 – 2012. The lowest price received for each strategy is arranged chronologically and derived from Table 1:

- Collar Strategy,
- Call Strategy,
- Futures (Spot) Strategy.

The collar strategy has the lowest minimum price, this is an advantage for the producer of white maize, thus purchasing at a lower price. It is evident that implementing a basic routine procurement strategy it is more beneficial than buying from the spot market.

Standard deviation: The standard deviation of the purchasing price received for a particular strategy is used as a statistical measure of annual price variability. The higher the standard deviation of annual purchasing prices of a specific strategy the more variable its returns. Interpretation of standard deviation of basic routine procurement strategies for white maize:

- Futures (Spot) Strategy: The Futures (Spot) Strategy has the lowest standard deviation,
- Call Strategy: The call strategy has the second lowest standard deviation,
- Collar Strategy: The collar strategy has the highest standard deviation.

Table 1 illustrates that the basic routine procurement strategies are better than the futures (spot) strategy. However, these statistical moments do not give you as a procurer or processor of grain a clear indication of which of the three strategies is the best. To gain more insight in the distribution of prices associated with each basic routine procurement strategy for white maize, the Cumulative Distribution Function of each of the three strategies will be portrayed in Figure 1.

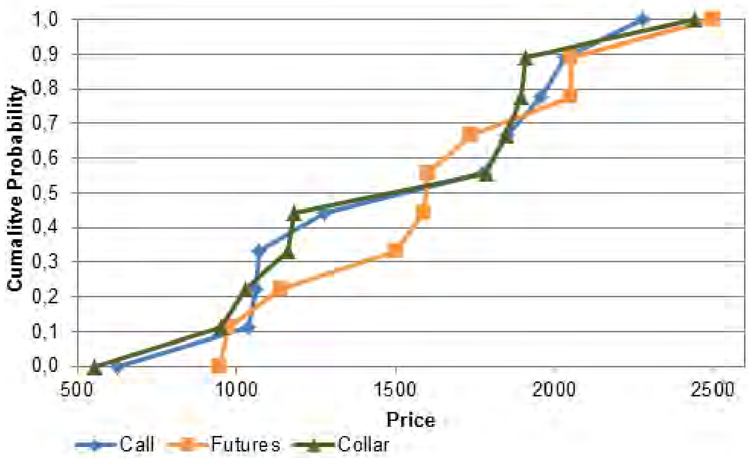

Figure 1. Cumulative Distribution Function for basic routine procurement strategies of white maize

The CDF illustrates if the producer decides to implement the futures (spot) strategy, there is a 28% probability for receiving a lower price. However, the minimum price that can be received for the futures (spot) strategy is much higher when compared to that other basic routine procurement strategies. This implies that the procurer of white maize will pay a higher minimum price for the white maize, this is not ideal due to the procurer want to purchase at the lowest possible price. The CDF also illustrates that both the call and collar routine procurement strategies have a 72% probability of receiving a lower minimum price for purchasing white maize compared to the futures (spot) price.

The trend of the CDF for both the basic routine procurement strategies are very similar, the one point gives some significant differences between the two is the presentation that a collar strategy would give a lower minimum price that the call strategy. With both these strategies showing very similar trends on the CDF lines of each, it is difficult to distinguish between which one of these two basic routine procurement strategies are better than the other.However it can be established that these two strategies outperform the futures (spot) price comprehensively, when trying to lock in at a minimum or lowest procuring/sourcing price for white maize.

Given the findings of statistical moments and the CDF, it was decided to create a theoretical milling firm which procures white maize and implements these strategies to determine if there is any financial benefit from doing these basic routine procurement strategies. The following assumptions were used: The milling company procures 1260 contracts on SAFEX, on the first business day of May in year one, and the expiry date of these contracts are twelve months in advance thus the fifth last business day of April one year on.

The milling company then agrees that each month 90 contracts of the 1260 contracts must be delivered to the firm until the numbers of contracts are zero. If the net price (Strike + Premium) in the options is lower than the price in the spot market the option is exercised, if the net futures (spot) (Spot + Premium) are lower, the futures (spot) will be exercised and then the price on the premium of the option is paid. These strategies have been repeated for ten year, year on year in exactly the same way. Figure 2 gives an indication to the reader on the total costs that were associated each year in the procurement of white maize over a ten year period, when implementing each strategy.

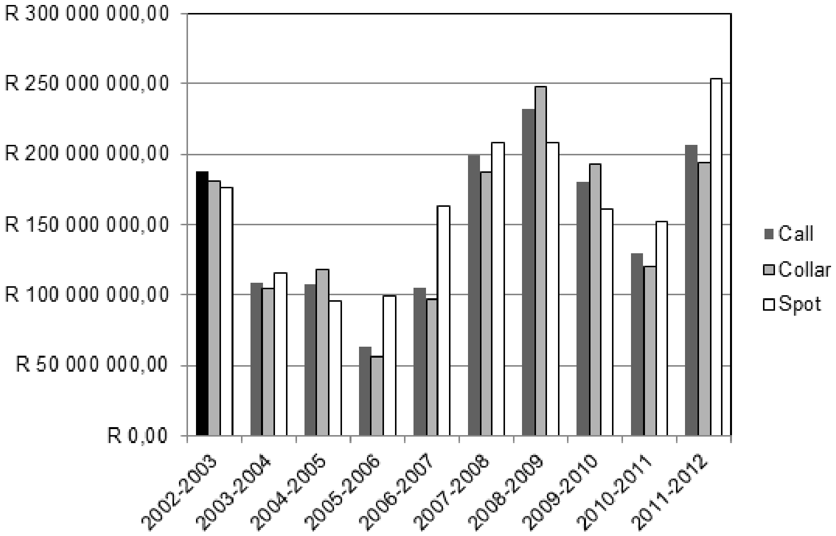

Figure 2. Total cost associated with each year

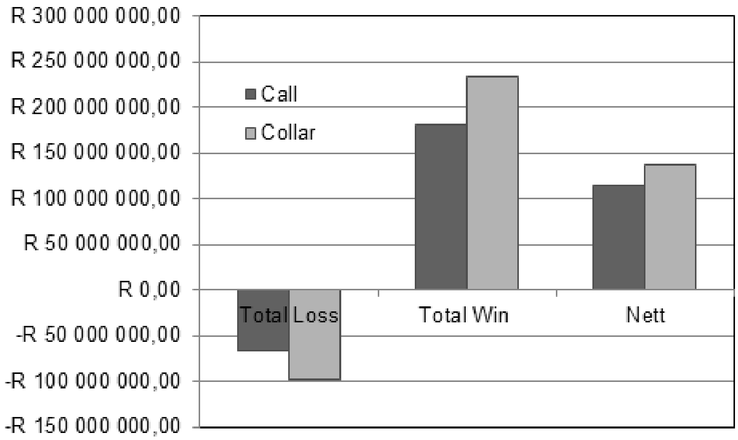

Figure 3. Total gains, losses and net gains

In figure 3 the reader is illustrated an indication on the winnings, losses and net gain by implementing these strategies over a ten year period. It has to be brought to the attention of the reader that the winnings were calculated by using the amount paid in a year to exercise the strategy and then taking the amount paid for the strategy and deducting that from what the procurer should have paid if the firm procured from the futures (spot) market.

The same principle applies for losses, where losses are calculated when the procurer made a loss by implementing the strategy where he could of performed better by procuring from the futures (spot) market. The winnings in comparison to the losses outperform the losses. The net gain is the Total winnings minus total losses over ten years. In table 2 the real cost incurred with each routine procurement strategy is revealed.

Table 2. Real values of total winnings, losses and net gain

	Call	Collar
Total Loss	-R 65 394 259.00	-R 97 232 814.79
Total Win	R 180 622 792.08	R 234 328 963.51
Nett gain	R 115 228 533.07	R 137 096 148.72

When interpreting figure 3 and table 2 it indicates that there are financial benefits when using basic routine procurement strategies to hedge lower prices.

5. Summary and conclusions

Various authors such as O'Brien (2000) and Scheepers (2005) proved that the derivative market is efficient in price risk management. The main objective of this research paper was to determine if basic routine sourcing procurement price hedging strategies for white maize are more efficient in locking in lower prices for the sourcing of white maize compared to buying on the futures (spot) market. The strategies that were used were a call strategy which is bought out-of-the-money, a collar strategy which is a combination of a call and put strategy, and then a baseline strategy future (spot). The call and collar strategy were compared to the futures (spot) strategy over ten years of market data received from the Johannesburg Stock Exchange Agricultural Product Division named SAFEX. The data was analysed using descriptive statistics to determine the significance of the data. Out of the descriptive statistics, evidence was obtained that the two basic routine procurement strategies can lock in lower prices than compared to buying on the futures (spot) market. However, by just using statistical analysis does not provide enough evidence that these strategies over power the future (spot) strategy. Thus a Cumulative Distribution Function was compiled to indicate what the probability will be in actually receiving a lower price by using the basic routine procurement strategies compared to futures (spot).

The author opted to create a theoretical milling company which basic routine sourcing price hedging strategies for white maize was used and, implemented over a ten year period. This theoretical firm gives an indication to the reader on the financial gains and loss possibilities by applying these basic routine procurement strategies over a ten year period. It can be concluded that many grain procuring firms use complex methods in price hedging or procuring raw material and in this case white maize. The research proves that by using basic routine procurement strategies it will be beneficial to the procurer than to just procure on the futures (spot) market.

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POTENTIAL PROFITABILITY OF STRIP INTERCROPPING WITH CORN AND SOYBEANS

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Abstract

Strip intercropping, the planting narrow strips of different crops side by side in the same field, can generate greater crop yields and total revenue than planting the equivalent number of acres in large, monoculture fields. Although experimental data have shown yield advantages are possible, few studies have considered the cost implications of intercropping implementation. We develop a systematic comparison of the relative net revenue differences for a large-scale (2,157 hectare) corn-soybean operation under conventional and strip intercropping production practices. Results suggest that because the yield premiums for strip intercropped corn were relatively larger than the yield penalty for soybeans, the intercropping practice generated more revenue per unit land than the same crops grown in monoculture within the field. When costs of machine ownership and operation were incorporated into the analyses, the total wage bill estimate was nearly double for strip intercropping, and machinery ownership costs were 90% higher with strip intercropping. A key conclusion is that strip intercropping would lead to net revenue improvements over a conventional production system only for high base prices for crops and for normal moisture conditions with the most favorable result occurring when corn has the highest relative price, wages are lowest and fuel is most expensive.

Keywords: strip intercropping, Partial Budget Analysis, farm management, cultivation practices

1. Introduction

Agronomic trials suggest that planting narrow strips of corn and soybeans side by side in the same field can generate greater total revenue than planting the equivalent number of acres in large, monoculture fields (Lesoing and Francis 1991, West and Griffith 1992). This approach, which is referred to as strip intercropping, may improve the efficiency of light reception for the taller crop (corn), though at the expense of shading the shorter soybean crop. Recently, trials reporting the effects of strip intercropping on corn yields in industry publications (Winsor 2011) have sparked the imagination of many farmers and affiliated professionals in the North American field crop sector, leading to increased interest in the potential profitability of such a change in cultivation practices. However, these trials did not consider the full cost-side ramifications of altered cropping systems for modern, large-scale corn and soybean production systems nor did these studies explore sensitivity of results to crop prices. Both are crucial for understanding the relative appeal of this cropping system to commercial U.S. farmers and are the focus of this work.

We develop a systematic comparison of the relative net revenue differences for a large-scale (2,157 hectare) corn-soybean operation under two cultivation systems: (1) traditional cultivation practices where each field involves monoculture cultivation of either corn or soybeans and (2) a strip intercropping system featuring narrow strips of corn and soybeans in each field. We begin by comparing farm-level gross revenue differences between the two systems under a range of relative corn and soybean prices, weather conditions and strip widths. Relative prices for corn and soybeans are critical as the existing agronomic trials suggest that, as the shorter crop, soybean yields suffer at the expense of improved corn yields. Hence, the strip intercropping regime is more attractive when relative corn prices are higher. Weather conditions are critical as some agronomic trials reveal that dry weather alters the competition for water among the edge rows of the two crops and that soybean edge rows suffer proportionally greater yield losses in dry conditions (Lesoing and Francis 1991; Bullock and Bullock 2012). Finally, the agronomic research suggests that yield effects are concentrated in the outer two rows of strips where light and water competition between the two crops is most intense (Bullock and Bullock 2012). Implementing wider strips implies that a smaller proportion of each crop will be subject to changes in yield. However, while enhancing yield effect for corn, smaller strips require more passes for planting, spraying and harvesting operations and smaller width equipment. Each has implications for the labor and capital expenses associated with the strip intercropping approach, which we explore for corn production.

2. Literature review

Past studies have focused primarily on yield impacts and yield components in a strip intercropping system. Gross revenues of strip intercropping systems and monoculture control systems have been compared as a way to evaluate the economic impact of the intercropping systems approach. A Purdue Study (West and Griffith, 1992) examined the yield effects by row for an 8-row strip intercropping system compared to a conventional mono-crop system over a 5 year period (1986-1990). With regular management, the outside row of corn in the intercrop system yielded 20% higher than the mono-crop check. Corn rows next to the border rows did yield higher as expected (5%) although the yield increases were much lower than the border rows. Outside border soybean rows yielded 22% lower than inner rows. This study also examined the potential for an increased level of management (“high management”) to produce larger corn yield responses. “High management” in this study consisted of increased seeding rates and nitrogen application amounts. The two outside rows in this study produced 27% higher corn yields than inner rows. Consistent with the “regular management” system, rows adjacent to the border rows yielded more than the inner rows but much less than the border rows. These rows adjacent to the border rows yielded 2% more than inner rows.

Corn strips in the intercropping system averaged 9% higher yields than monoculture corn while soybean yields in the strip intercropping system averaged 12% less than the monoculture check. West and Griffith found that the value of the additional corn yield in the intercropped system was almost entirely offset by the reduced value of lower soybean yields. Returns to a strip intercropping system in their study were $3.26 per hectare for “regular management” plots and $9.02 per hectare for “high management” plots.

A similar study by Lesoing and Francis examined the effects of strip intercropping on yield and yield components of corn, grain sorghum and soybeans in eastern Nebraska. Conducted from 1988 through 1990, this research examined corn-soybean intercropping systems and grain sorghum-soybean intercropping systems under both rain-fed and irrigated conditions. Corn border rows showed significant yield improvement over inner rows in all years in both rain-fed and irrigated conditions. Corn border row yield improvement ranged from a high of 31% in the 1989 irrigated plots to a low of 10% improvement in the 1988 rain-fed plots. In line with predictions, soybean border rows in intercropped plots showed marked declines in yield. Soybean border rows had yields 2 to 31% lower than inner rows depending on year and moisture conditions. The system with the largest border row soybean loss was the 1989 irrigated system with a 31% yield loss. The plot intercropped system with the smallest soybean yield loss was the 1988 rain-fed system with a 2% yield loss.

Lesoing and Francis found that corn-soybean strip intercropping returned $14 to $25 more gross revenue per hectare than monoculture systems in this study, although these differences were not statistically significant. Based on this three year study, there is no revenue advantage to the strip intercropping system.

An Illinois study by Bullock and Bullock evaluated the performance of a corn-soybean strip intercropping system in 2009-10. The two year study encountered two distinct moisture environments. Normal moisture in 2009 and below normal moisture in 2010 allowed these researchers to evaluate these systems under two different moisture environments. This research found significant improvement in border row corn yields. Under normal moisture conditions (2009), border row corn yields were 41% higher than inner rows in this 6 row corn intercropped strip. Rows adjacent to border rows had a yield increase of 14% over inner rows. Soybean yields on the other hand, showed marked decreases. Border row soybeans yielded 15% less than inner rows while rows adjacent to border rows yielded 8% less than inner rows. In the below normal moisture environment in 1990, border row corn yields again showed marked increases of 51% over inner rows while yields of rows adjacent to border rows were 17% higher than inner rows. Soybean yields were more severely affected in this below normal moisture setting. Border row soybean yields in 1990 were 57% lower than inner rows while rows adjacent to border rows were 16% lower than inner rows.

Table 1. Yield Effects for Corn and Soybean from the Extant Literature

Source	Moisture Status/ Management	Crop Year	Unit	Corn Outer Row	Corn 2nd Row	Corn Inner Rows	Soy Outer Row	Soy 2nd Row	Soy Inner Row
Leosing and Francis 1991	Below normal moisture	1988	Mg/ha	6.77 (+10%)	NR	6.13	1.43 (-5%)	NR	1.51
Leosing and Francis 1991	Below normal moisture	1989	Mg/ha	9.13 (+30%)	NR	7.01	1.86 (-22%)	NR	2.39
Leosing and Francis 1991	Near normal moisture	1990	Mg/ha	8.7 (+16%)	NR	7.48	1.89 (-23%)	NR	2.46
Leosing and Francis 1991	Irrigated	1988	Mg/ha	11.0 (+19%)	NR	9.23	1.69 (-2%)	NR	1.73
Leosing and Francis 1991	Irrigated	1989	Mg/ha	15.3 (+31%)	NR	11.7	1.86 (-31%)	NR	2.70
Leosing and Francis 1991	Irrigated	1990	Mg/ha	13.8 (+28%)	NR	10.8	1.66 (-26%)	NR	2.25
West and Griffith 1992	Normal Moisture-Regular Mgt.	1986 - 1990	Mg/ha	13.41 (+20%)	11.68 (+5%)	11.15	2.34 (-22%)	2.91 (-3%)	2.99 (3.2)[a]
West and Griffith 1992	Normal Moisture-High Mgt.	1986 - 1990	Mg/ha	14.3 (+27%)	11.5 (+2%)	11.24	2.34 (-22%)	2.91 (-3%)	2.99 (3.2)[a]
Bullock and Bullock 2013[b]	Normal moisture	2009	Mg/ha	19.5 (+41%)	15.7 (+14%)	13.8	3.3 (-15%)	3.6 (-8%)	3.9
Bullock and Bullock 2013[b]	Below normal moisture	2010	Mg/ha	15.7 (+51%)	12.2 (+17%)	10.4	2.1 (-57%)	3.1 (-16%)	3.7

Notes: NR – not reported. Numbers in parentheses are the percent deviation from inner row yield, [a] Average of 8 row monoculture control over this period, [b] Awaiting publication

3. Gross revenue impacts

In this section, we compare the value of the corn yield premiums and soybean yield penalties based on data from the literature review for alternative strip widths. Differences in the costs of production between the cultivation systems will be considered in the next section. Our analyses are based on data from Bullock and Bullock (2012). We focus on these results because these experimental results span two recent years with modern seed genetics featuring typical growing conditions one year and dryer than normal conditions the next. Table 2 summarizes the yield impacts for corn and soybeans from these trials. Corn yield in the outer rows of the strip averaged 141% of the center row yields in the normal weather year, and about 151% of center row yields in the dry weather year. The second row corn yield was about 114 and 117% of center row yields for the normal and dry year, respectively. Soybeans, on the other hand, realized lower yields in the outer two rows: outer row yields were 84 and 57% of center row yields in normal and dry years, respectively, whereas second row yields were 92 and 85% of center row yields in normal and dry years.

Table 2. Yield by Row from Bullock and Bullock's Strip Intercropping Field Trials

	Corn		Soybeans	
Row	Normal	Dry	Normal	Dry
1st (edge)	19.5	15.7	3.3	2.1
2nd	15.7	12.2	3.6	3.1
Center	13.8	10.4	3.9	3.7

Notes: Yields in metric tons/hectare from field trials in Illinois during 2009 and 2010. Source: personal communication with authors

Assuming that yield effects are limited to the outer two rows of the strip as described in Table 2, we estimate the gross revenue values for strip intercropping using various strip widths by assuming that any rows other than the two outside match the yield of the center rows from the Bullock and Bullock trials. We then compare this to the gross revenue for the conventional case – two fields of equal acreage, one of which is planted entirely in corn and the other in soybeans where all rows have a yield equivalent to the center rows from Table 2. For the moment we ignore the requirement of differing sized planting, spraying and harvesting equipment: we simply assume that the farm has sufficient equipment of appropriate size to allow the strips to be planted within the same time window as for the conventional case. That is, in this analysis we are not allowing for the possibility of delayed field operations and possible planting-delay yield penalties.

We make gross revenue calculations for strip widths of 4, 6, 8, and 16 rows for both typical and dry weather conditions where corn is planted in 30-inch rows and soybeans are planted in strips of width equal to the corn strips. We also explore two levels of base crop prices (high and low) and three levels of relative crop prices (soy/corn price ratios of 2.0, 2.5 and 3.0). The base corn price under the low price scenario is $157/T while the base corn price under the high price scenario is $275/T for corn; soybean prices will be 2.0, 2.5 or 3.0 times the given corn price.

Table 3. Intercropping Gross Revenue Comparisons ($/hectare)

System	Strip Width in Rows				
	4	6	8	12	16
Conventional	$1,852	$1,852	$1,852	$1,852	$1,852
Strip Intercrop	$2,044	$1,972	$1,933	$1,891	$1,866
Absolute Difference	$191.66	$119.49	$81.30	$38.89	$13.46
% Difference	10.35	6.45	4.39	2.10	0.73

Notes: Headlands planted to soybeans and encompass two times the number of rows in each strip. Soy and corn prices are $368 and $157/metric ton, respectively (2.5 price ratio). Scenario captures normal moisture and lower absolute prices. No cost differences incorporated

Table 4. Sensitivity of Gross Revenue Differences to Price Ratio, Price Level and Moisture

	Soy/Corn Price Ratio		
Price Level/Moisture	2.0	2.5	3.0
Low Price, Low Moisture	$70 (5.0%)	$49 (3.2%)	$25 (1.5%)
Low Price, Normal Moisture	$125 (7.4%)	$119 (6.4%)	$112 (5.6%)
High Price, Low Moisture	$123 (4.0%)	$85 (3.2%)	$45 (1.5%)
High Price, Normal Moisture	$219 (7.4%)	$208 (6.4%)	$197 (5.6%)

Notes: All figures compare gross revenue per hectare from 6-row strips to conventional cultivation. Low prices are based on $157/T for corn while high prices are $276/T for corn. Soy prices are 2.0, 2.5 or 3.0 times the price of corn as indicated in the column heading

Table 3 displays the results of the gross revenue comparisons for the case of typical weather and lower commodity prices for 5 strip widths. The conventional system assumes center row yields for the entire acreage, and is displayed in the table with a constant gross revenue ($1,852/ha) for all strip width comparisons. For the strip intercropping case, gross revenue was greatest ($2,044/ha) for the 4-row strip width, declining to $1,866/ha for the 16-row strip width. Because the yield premiums for strip intercropped corn were relatively larger than the yield penalty for soybeans, the intercropping practice generated more value per unit land than the same crops grown in monoculture within the field. For the case displayed in Table 3, the gross revenue advantage ranged from $192/ha (10.4%) for the 4-row strips, to a modest $13/ha (0.7%) advantage for 16-row strips.

Table 4 shows the advantage of strip intercropping at a 6-row width relative to conventional plantings for both normal and dry weather conditions, for higher and lower base commodity prices and for different ratios of soy to corn prices. The most favorable constellation of conditions features normal weather conditions, high base prices for crops and low soy/corn price ratios. In this setting strip intercropping yields $219 more gross revenue per hectare than the conventional system. This gross revenue advantage shrinks to $25 per hectare if base prices are low, the soy/corn price ratio is high and moisture is low.

4. Cost impacts

Revenue is only one side of the ledger when considering such a substantial change in cultivation practices. We explore differences in labor and machine costs for a 2157 hectare corn/soybean operation to implement 4.6 meter strips of corn (6 rows). All other costs, including seed, chemical and marketing costs, are assumed to be identical between the systems. Further, in the present analysis, we detail cost differences for corn only and assume soybean cost differences will follow in fixed proportion.

Several practical differences between the cultivation systems have cost implications that are immediately apparent. First, in many areas, corn and soybeans are often planted, sprayed and harvested at different times of the year, necessitating that each field in an operation will have to be visited twice in a year for each operation. The alternative would involve planting either corn or soybeans outside of its ideal planting window. This would likely affect yield potential and is not considered in this analysis.

Second, great economies of size have been gained by farmers who utilize large-scale planters, sprayers and harvesters capable of covering swaths of crop considerably wider than the 4.6-meter/6-row strips considered in this analysis of strip intercropping. Hence, additional labor and machinery is required to sustain production at the large scale and narrow widths considered. Table 5 outlines the machinery requirements for traditional tillage while Table 6 provides an equivalent

Table 5. Machinery Inventory Assumptions for Corn Operations for Conventional Cropping Practices

Inventory List	Width (m)	List Price	Field Efficiency	Operational Cost/ha	Field Capacity (Ha/hr)	Fuel use (l/ha)	Total fuel use per machine (l)	Total Machine Use (hr/yr)	Fixed transition time b/w fields (hr)	Total Transit time b/w fields (hr/machine)	Labor cost ($/yr)
Chisel Plow	7.3	$22,500	0.85	$2.84	5.58	10.38	11163	192.75	0.5	10.1	2637.09
Field cultivator	14.3	$70,500	0.80	$8.87	10.32	5.61	6057	104.58	0.5	10.1	1490.82
Boom Sprayer, Self Prop	27.4	$211,500	0.65	$26.63	16.03	3.18	3476	201.65	0.5	10.1	2752.31
Fertilizer Spreader’	13.7	$40,500	0.70	$5.09	8.62	6.73	7230	124.83	1.0	20.1	1884.10
16 Row Planter	12.2	$85,500	0.75	$10.77	8.22	7.02	7591	131.07	2.5	50.1	2355.24
Anhydrous Applicator	12.2	$27,000	0.80	$3.41	8.78	6.64	7117	122.88	1.5	30.1	1988.74
Combine 400 HP	6.1	$247,500	0.65	$31.18	3.56	23.20	25025	302.47	2.0	40.1	4453.90
Corn Head 8 Row	6.1	$45,000	0.65	$5.66	3.56	-----		302.47			
Semi Tractor/Trailers (2x)		$70,000		$8.82		-----	-----	-----			
Grain Cart, 900 bu		$22,500		$2.84		16.28	17518	302.47	0.5	10.1	4063.46
310 HP Tractor		$193,500		$48.75			----	338.06			
250 HP Tractor		$156,048		$39.31			----	338.06			

Notes: Assumes 9 km/hr field operation speeds for all practices, 20 km/hr transportation speed between fields, except for the combine, which is 15 km/hr, labor cost of $13/hr for all machine operation time. Assumes three passes with boom sprayer. Fuel use is a function of horsepower and field capacity. Assumes machinery visits 20 fields as corn is planted in half of farm’s fields. Assumes all fields are 2 km apart for transport. Each field assumed to be 53.9 acres for a total of 1078 hectares of corn

Table 6. Machinery Inventory Assumptions for Corn Operations for Strip Intercropping Practices

Inventory List	Width (m)	List Price	Field Efficiency	Non-fuel Operational Cost/ha	Field Capacity (Ha/hr)	Fuel use (l/ha)	Total fuel use per machine (l)	Total Machine Use (hr/yr)	Fixed transition time b/w fields (hr)	Total Transit time b/w fields (hr/ machine)	Labor cost ($/yr)
Chisel Plow (3x)	2.1	$6,563	0.90	$2.47	1.74	5.99	2152	208.05	0.5	6.8	2792.63
Field cultivator (3x)	4.6	$22,500	0.85	$8.50	3.48	2.99	1063	102.80	0.5	6.8	1424.39
Boom Sprayer, pull (5x)	4.6	$17,625	0.80	$11.10	3.28	3.18	678	65.54	0.5	4.1	905.27
Fertilizer Spreader (2x)	6.7	$32,063	0.85	$4.99	5.14	2.05	1087	105.14	1	20.1	1628.09
6 Row Planter (3x)	4.6	$32,063	0.90	$12.11	3.68	2.81	1004	97.09	2.5	33.4	1696.81
Anhydrous Applicator (3x)	4.6	$10,125	0.90	$3.83	3.68	2.81	1004	97.09	1.5	20.1	1523.48
Combine 300 HP (2x)	4.6	$185,625	0.75	$46.75	3.08	20.11	10845	174.77	2	40.1	2793.76
Corn Head 6 Row (2x)	4.6	$33,750	0.75	$8.50	3.08	-----		174.77			
2 Semi Tractor/Trailers		$70,000		$8.82		----	----	-----			
Grain Cart, 200 bu (4x)		$5,000		$1.26		1.68	904	87.39	0.5	10.1	1267.31
50 HP Tractor (5x)		$31,210		$19.64			-----	480.52			

Notes: 3x means the farm operates 3 identical units. Assumptions include: 9 km/hr field operation speeds for all practices, 20 km/hr transportation speed between fields, except combine, which is 15 km/hr, labor cost of $13/hr for all machine operation time. Assumes three passes with boom sprayer. Fuel use is a function of horsepower and field capacity. Assumes machinery visits all 40 of the farm's fields as corn is planted in each field as part of the intercropping strategy. Assumes all fields are 2 km apart for transport. Each field assumed to have 26.96 hectares of corn (half the field area) for a total of 1078 hectares of corn view for strip intercropping. Each system features many items with identical functions: tractor, chisel plow, field cultivator, fertilizer spreader, planter, anhydrous ammonia applicator, chemical sprayer, combine harvester with corn head, grain carts, and semi-trailer truck.

The difference between the systems is in the number of items needed and the width of each item. The inventory for the traditional system is chosen to meet the timeliness needs for planting, spraying and harvesting windows given the area covered. The strip intercropping inventory was chosen to replicate the timeliness of production obtained under the traditional cultivation system. For example, under both systems, we assume the corn requires spraying three times during the growing season. In the traditional system, the 27.4 meter self-propelled boom sprayer, which has an assumed field efficiency of 0.65, operational speed of 9 km/hr and an associated field capacity of 16.03 hectares per hour, accomplishes its three passes in 201.65 hours. In the strip intercropping system, we assume sprayer width matches strip width (4.6 meters). These smaller tractor-pulled sprayers are assumed to have a greater field efficiency due to narrow width (0.80) and an identical operational speed (9 km/hr). However, the significantly narrower width drives down field capacity to 3.28 hectares per hour, about one-fifth the capacity of the 27.4 meter self-propelled boom sprayer. To ensure the same three passes occur during the same time window, the strip intercropping machinery inventory includes five of the smaller tractor-pulled boom sprayers. Similar calculations were used to arrive at the need for three chisel plows, three field cultivators, two fertilizer spreaders, three planters, three anhydrous applicators, two combines and four grain carts. Five tractors were needed to allow all pull sprayers to be used simultaneously, though the tractors a substantially smaller as the narrower machinery implements require fewer horsepower for operation.

Tables 5, 6 and 7 capture the differential fuel use required to undertake corn operations between the two systems. More total hours spread across multiple implements are needed to complete field operations for strip intercropping (3135 vs. 1664, or about 86% more). However, the smaller widths imply that each propulsion unit uses significantly fewer horsepower to accomplish each operation. Indeed the total horsepower brought to bear for the strip intercropping operation is 30% less, with 850 (50 hp tractor x 5 + 300 hp combine x 2) versus 1,210 for the conventional approach (250 hp tractor + 310 hp tractor + 400 hp combine + 250 hp sprayer). This results in nearly 50% less fuel use per hectare for strip intercropping.

In our assessment we assume that 1078.5 hectares of corn are planted under both a traditional and under a strip intercropping system. Under traditional cultivation corn is planted in half of the 40 fields, while under strip intercropping corn is planted on half the area in each of the 40 hypothetical fields. In both cases, a 2 km travel distance between fields is assumed, though we assess the sensitivity of cost results to

Table 7. Machinery and Labor Cost Comparison of Standard and Strip Intercropping System for Corn Operations

Measure	Strip intercrop	Standard
Total field hours	2752	1483
Between field transition hours	383	181
Total hours	3135	1664
Hours/hectare	2.91	1.54
Total wage bill	$40,751	$21,626
Wage/hectare	$37.79	$20.05
Machinery ownership costs/ hectare	$369	$194
Fuel cost/hectare	$43.89	$80.32
Total Machinery & Labor Costs/hectare	$450.57	$294.55
Ratio: Strip/Standard	--	1.53
Difference: Strip/Standard ($/ hectare)	--	$156.02

Notes: Assumes $13/hour wage, $0.92/liter fuel price and 2.0 km travel distance between fields changes in the assumption of between field distance.

Table 7 provides a side-by-side comparison of machinery and labor costs associated with corn production under the two systems. The table reveals the core results of this partial budgeting exercise: labor and machinery ownership costs are higher under strip intercropping though fuel costs are less. The total wage bill is nearly double, as both field hours and hours spent in transition are considerably higher with strip intercropping. Machinery ownership costs, which consist of repairs, depreciation, interest, insurance and housing, are 90% higher with strip intercropping. While the smaller equipment may require less fuel, the sheer quantity of items means a dramatically higher ownership cost.

Table 8. Machinery and Labor Cost Comparison of Standard and Strip Intercropping System for Corn Operations: Sensitivity Analysis

	Wage = $9	Wage = $13	Wage = $17
Fuel = $0.73/l, 2 km b/w fields	$158.37 (1.58)	$163.83 (1.59)	$169.28 (1.60)
Fuel = $0.92/l, 2 km b/w fields	$150.56 (1.52)	$156.02 (1.53)	$161.47 (1.54)
Fuel = $0.92/l, 0.2 km b/w fields	$150.54 (1.52)	$156.00 (1.53)	$161.45 (1.54)
Fuel = $1.12/l, 2 km b/w fields	$142.75 (1.47)	$148.21 (1.48)	$153.67 (1.48)

Notes: $/hectare difference (strip intercrop – conventional) is top number in each cell. Ratio of strip intercrop to conventional cost in parentheses. Bolded cell reflects base assumptions. All other parameters not listed in a column or row heading match those of the base assumption

For all elements of this partial budget, we find strip intercropping to cost about $156 more per hectare than the conventional approach, representing a 53% increase in these core costs. Table 8 documents how three key assumptions – wage rate, fuel price and distance between fields, alters the core cost finding. We explore a wage rate change from base of +/- 30%, a fuel cost change of +/- 21% and reduction in distance between fields by an order of magnitude. The ratio of costs between strip intercropping and conventional systems is most sensitive to fuel price changes, next most sensitive to wage changes and nearly insensitive to changes in the distance between fields. The combination that makes the cost of strip intercropping most competitive is the scenario with lower wages and higher fuel costs. In this case strip intercropping is only 47% more costly than conventional. For the highest wages and lowest fuel cost, strip intercropping is about 60% more expensive than conventional.

5. Overall impacts

Tables 9 and 10 bring together gross revenue changes and cost changes affiliated with a change from the conventional system to a strip intercropping system, where negative figures are denoted in parentheses and represent situations where strip intercropping would result in a decrease in net revenue compared to a conventionally cultivated operation. In table 9, we assume that cost differences for soybeans are identical to the cost differences for corn detailed in the previous section. The table presents changes in net revenue per hectare for an array of assumptions concerning crop price levels, crop price ratios, moisture conditions, wage rates and fuel costs. The critical result is that strip intercropping would lead to net revenue improvements over a conventional production system only for high base prices for crops and for normal moisture conditions with the most favorable result occurring when corn has the highest relative price, wages are lowest and fuel is most expensive. In this setting strip intercropping would return $76 more per hectare than the conventional operation. In any scenario featuring either low moisture conditions or low base crop prices, strip intercropping would results in lower net revenue than a conventional operation, with the least favorable scenarios generating up to $131 fewer per hectare.

Table 9. Difference in Net Revenue for Corn and Soybean Operations: Soybean Cost Difference Same as Corn

Levels for Output Price, Moisture	Wage = $13, Fuel = $0.92 Soy/corn price ratio			Wage = $17, Fuel = $0.73 Soy/corn price ratio			Wage = $9, Fuel = $1.12 Soy/corn price ratio		
	2.0	2.5	3.0	2.0	2.5	3.0	2.0	2.5	3.0
Low Price, Low Moisture	$(86)	$(107)	$(131)	$(99)	$(121)	$(144)	$(72)	$(94)	$(117)
Low Price, Normal Moisture	$(31)	$(37)	$(44)	$(44)	$(50)	$(57)	$(18)	$(23)	$(30)
High Price, Low Moisture	$(33)	$(71)	$(112)	$(46)	$(84)	$(125)	$(19)	$(57)	$(98)
High Price, Normal Moisture	$63	$52	$41	$50	$39	$27	$76	$66	$54

Notes: $ per hectare: Strip intercropping – conventional from partial budget analysis summing changes in gross revenue and changes in labor and machinery costs from previous tables. Figures in parentheses denote negative values. Assumes cost differences to produce soybeans in strips are the same as the cost differences for producing corn in strips

Table 10. Difference in Net Revenue for Corn and Soybean Operations: Soybean Cost Difference 15% less than Corn

Levels for Output Price, Moisture	Wage = $13, Fuel = $0.92 Soy/corn price ratio			Wage = $17, Fuel = $0.73 Soy/corn price ratio			Wage = $9, Fuel = $1.12 Soy/corn price ratio		
	2.0	2.5	3.0	2.0	2.5	3.0	2.0	2.5	3.0
Low Price, Low Moisture	$(74)	$(96)	$(119)	$(86)	$(108)	$(131)	$(62)	$(83)	$(107)
Low Price, Normal Moisture	$(19)	$(25)	$(32)	$(31)	$(37)	$(44)	$(7)	$(13)	$(20)
High Price, Low Moisture	$(21)	$(59)	$(100)	$(33)	$(71)	$(112)	$(9)	$(47)	$(88)
High Price, Normal Moisture	$75	$64	$52	$62	$52	$40	$87	$76	$65

Notes: $ per hectare: Strip intercropping – conventional from partial budget analysis summing changes in gross revenue and changes in labor and machinery costs from previous tables. Figures in parentheses denote negative values. Assumes cost differences to produce soybeans in strips are 15% less than the cost differences for producing corn in strips

Table 10 calculates the same results under the assumption that the relative cost of production for soybeans under strip intercropping versus conventional is not as much as it is for corn. Specifically we look at a setting where the cost increases are 15% less than the cost increases for strip intercropping corn. Given that soybeans would not require an anhydrous ammonia application, and may require one less spray pass, such an assumption may be reasonable. Even with this more favorable assumption for strip intercropping, the general pattern of results is similar in Table 10 as in Table 9 – only scenarios with high base crop prices and normal moisture lead to higher net revenue under strip intercropping. Each entry is approximately $10 -$12 per hectare more favorable to strip intercropping under the assumptions maintained in Table 10.

6. Discussion and conclusions

Strip intercropping is viewed as an opportunity to increase total crop production primarily because of greater efficiency of sunlight capture. Our analyses show that because the yield premiums for strip intercropped corn were relatively larger than the yield penalty for soybeans, the intercropping practice generated more value per unit land than the same crops grown in field-level monoculture.

Projecting from yield effects in recent Illinois field trials, we find the gross farm revenue improvements involved in implementing strip intercropping ranged from less than one percent to 12 percent. Narrower strips yielded substantially larger gross revenue relative to monoculture. Expansion to wider strip widths increasingly dilutes the higher-yield edges with wider center row segments, resulting in lower average yields and gross revenues. For example, in a year with normal rainfall and high prices ($276/T corn and $643/T soybeans), implementing 4-row corn strips yields an increase in gross revenue per hectare of $335 (10%) over monoculture, while a 6-row corn strip yields only a $208/hectare improvement. In a dry year, the additional revenue from a 4-row corn strip drops to about $134/ha.

Commodity price also is important, both in terms of absolute level and the relative level of prices for the crops in strips. A drop in commodity prices from $276/T corn, $643/T soybeans to $157/T corn, $367/T soybeans results in a decline in the 4-row strip advantage of $143/ha, assuming typical weather. Because corn yields increase while soybean yields decline over the strip cropped area, an increase (decrease) in the soybean/corn price ratio decreases (increases) the revenue advantage of strip intercropping.

Of course, revenue is only one side of the ledger when considering such a substantial change in cultivation practices. We explore differences in labor and machine costs for a 2157 hectare corn/soybean operation to implement 4.6 meter strips of corn (6 rows). All other costs, including seed, chemical and marketing costs, are assumed to be identical between the systems. More total hours spread across multiple implements are needed to complete field operations for strip intercropping. The total wage bill is nearly double for strip intercropping, as both field hours and hours spent in transition are considerably higher. Machinery ownership costs are 90% higher with strip intercropping as more, smaller implements and tractors are required to accomplish operations in a timely fashion. A key conclusion is that strip intercropping would lead to net revenue improvements over a conventional production system only for high base prices for crops and for normal moisture conditions with the most favorable result occurring when corn has the highest relative price, wages are lowest and fuel is most expensive. In this scenario, strip intercropping would return a modest $76 more per hectare than the conventional operation. In other less favorable scenarios, increased costs of strip intercropping typically exceeded improvements in revenues.

These analyses do not consider the one-time costs of altering the machinery complement to allow the strip production system with narrow strips. Such transitional investment requirements might be a significant deterrent to farmer adoption of strip intercropping. On the other hand, our analyses also ignores possible yield boosts from decreased compaction resulting from the smaller equipment used in strip intercropping. Compaction related yield penalties are well documented, but their effect has not be isolated or the accumulated effect traced over time in current agronomic and pilot tests of strip intercropping yield comparisons. Further, additional work is needed to consider the potential profitability for smaller operations that currently possess smaller capacity equipment and may have the capability to expend additional time to plant, spray and harvest smaller strips without risking timeliness of each operational step. Also, we do not consider how row-specific management approaches within a strip intercropped system might affect yields or net revenues, where different planting populations and fertilizer levels for edge rows could spur further yield boosts for corn. Finally, all analyses here assume the prevailing machinery technology is employed for both monoculture and strip intercropping production systems. The advent of radical new technologies, for instance, small supervised autonomous (robotic) equipment, might greatly alter the cost calculus for farming small strips, allowing capture of yield advantages of very narrow strips without the much higher machine and labor costs calculated in this study.

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TREASURING TREES FOR AGRICULTURAL TRANSFORMATION

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Abstract

Trees are vital to earth's ecosystem. In many places, loss of trees is faster than their replacement. With particular reference to sub-Saharan Africa, this paper seeks to review in outline the value of trees in order to encourage better understanding, appreciation and practical management response. A treasury is a store of wealth, a treasurer its custodian, and the act of treasuring is a positive response to the value of that wealth. Trees are a multi-faceted source of wealth. Not just foresters and forest communities but especially farmers, and also civil societies, families and individuals at large need to care about and for trees. The paper briefly indicates the global status of forests, their ecological and economic significance, and proposes tree-treasuring strategies and practices together with their integration in agro-ecological systems for global food security. While recognising the excellent work that is being done in some places, it is a wider call for deeper appreciation and fresh endeavours concerning trees and their integral management within farming systems. The paper also reports responses to practical field workshops on trees held in Malawi in 2012.

Keywords: trees, treasuring, agro-ecological, integral, management, extension

1. Introduction

Forests cover some 3.9 billion hectares (9.6 billion acres) which is approximately 30% of the World's land surface. FAO (2012) estimates that around 13 million hectares of forests were converted to other uses or lost through natural causes annually between 2000 and 2010. Their estimated annual rate of forest area increase was 5 million hectares. Globally, the highest proportion of land under forest is in the tiny African nation of Gabon. Rwanda scored the highest global rate of forestation during the decade 2000-10, with around +6.5% per annum, while within Africa, Zambia had the greatest proportion of its land area under national protection (some 41%). In Africa, the largest concentration of forest is found in the Congo basin covering some 1.3 million km². On the other hand, the fastest rates of deforestation recorded globally during 2000-2010 were in Africa: Burundi (5.5%); Togo (4.7%); Nigeria (3.5%). The challenge for Africa is clear (Maathai, 2009) with much of countries like Malawi largely deforested with farmland and 'mango-savanna' instead, owing especially to huge woodfuel demands of the rising population. Informal surveys by the author of some 350 families in rural Malawi in 2006 indicated that the average family spent 30-35% of disposable monthly income on acquiring woodfuel, most of it burnt wastefully to cook on 3 large stones. FAO (2011) notes:-

- Forests are home to 300 million people world-wide, formally employing 14M.
- More than 1.6 billion people depend to varying degrees on forests for their livelihoods, e.g. fuelwood, medicinal plants and forest foods.
- About 60 million indigenous people are almost wholly dependent on forests.
- Some 350 million people who live within or adjacent to dense forests depend on them to a high degree for subsistence and income.

In developing countries, about 1.2 billion people rely on agroforestry farming systems that help to sustain agricultural productivity and generate income.

Mangrove forests, which cover about 15 million hectares worldwide, are essential to the life cycles of the majority of the world's commercial fish species.

2. Treasure

Trees should be valued at various levels (Fig.1) – intrinsically as God's creation, as notable specimens and as landscape features, for their products, for their protection and for their global ecosystem role. Trees are treasured by some as ethical investments (Geographical, 84, No.8. p.73, August 2012), where *Ethical Forestry* (www.ethicalforestry.com) cites a *Moneyweek* claim 'forestry is the only asset class in existence that has risen in three out of the four market collapses of the 20th century'. Timber is uncorrelated to stock markets with almost sixfold investment growth projected over 12 years.

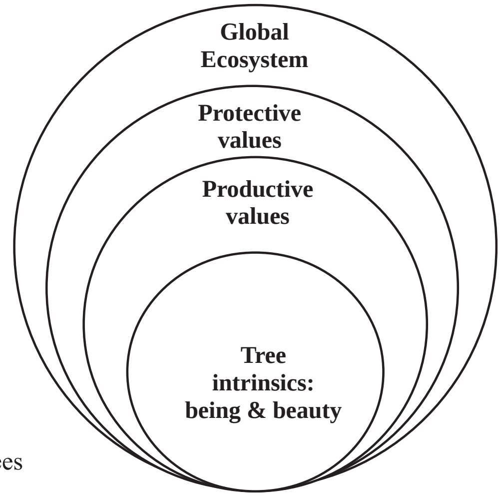

Figure 1. Levels of values to treasure in trees

FAO's 9th biennial issue of ***State of the World's Forests***, published at the outset of 2011, the International Year of Forests, considers the theme 'Changing pathways, changing lives: forests as multiple pathways to sustainable development'. It takes a holistic view of the multiple ways in which forests support livelihoods and should be valued. Chapters assembled for the 2011 *State of the World's Forests* highlight four key areas that warrant greater attention: regional trends on forest resources; the development of sustainable forest industries; climate change mitigation and adaptation; and the local value of forests. Considered together, these themes provide insights on the true contribution of forests to the creation of sustainable livelihoods and alleviation of poverty. Global forest cover (Table 1) is 93% natural, 7% planted.

The 'Great Green Wall' of trees proposed in 2012 by Dennis Garrity of World Agroforestry Centre (formerly ICRAF; www.worldagroforestry.org – '*Transforming Lives & Landscapes*') will extend from the Senegalese coast to the Djibouti coast upon completion. It can be achieved when practices such as Evergreen Agriculture are used against desertification because its affordable, sustainable and accessible farming methods benefit not only rural smallholder farmers but also the environment, encouraging ago-ecological farming systems among the world's around 500 million farm families (Wibberley, Turner, 2012).

To treasure trees, one needs to appreciate something of the rich international diversity of species (Dalziel, J.M., 1937; Hora, 1981; Van Wyk, Van Wyk, 1997; Fay, Nichols, 2009), current

Table 1. Global Forest Cover 2010

Place	Forest Mha	Total land Mha	Forest as % total land
Africa	674	2974	23
Asia	593	3091	19
All Europe	1005	2215	45
N&C America	705	2135	33
S. America	864	1746	49
Oceania	191	849	23
World	4033	13011	31

Source: www.forestry.gov.uk/statistics 2011

realities (CFA, 2010; FAO, 2012) and the history of forests – at least in one's own country (Hinde, 1985; Collett, 1993). For instance, the evergreen red mahogany or *mbawa* (*Khaya anthotheca* = *K.nyassica*) is fittingly the national tree of Malawi. Also among Malawi's special trees is *Aleurites montana* (of *Euphorbiaceae*) introduced in 1931 as a source of tung oil exported for paints and varnishes. A splendid allegory of the value of tree planting has been published, republished and dramatised since it first appeared (Giono, 1954). The spiritual significance of trees perhaps relates in part to the fact that many of them and their associated forests far transcend the span of a human life. There are baobabs in Africa and olive trees in the Garden of Gethsemane in Jerusalem known to exceed 3,000 years of age.

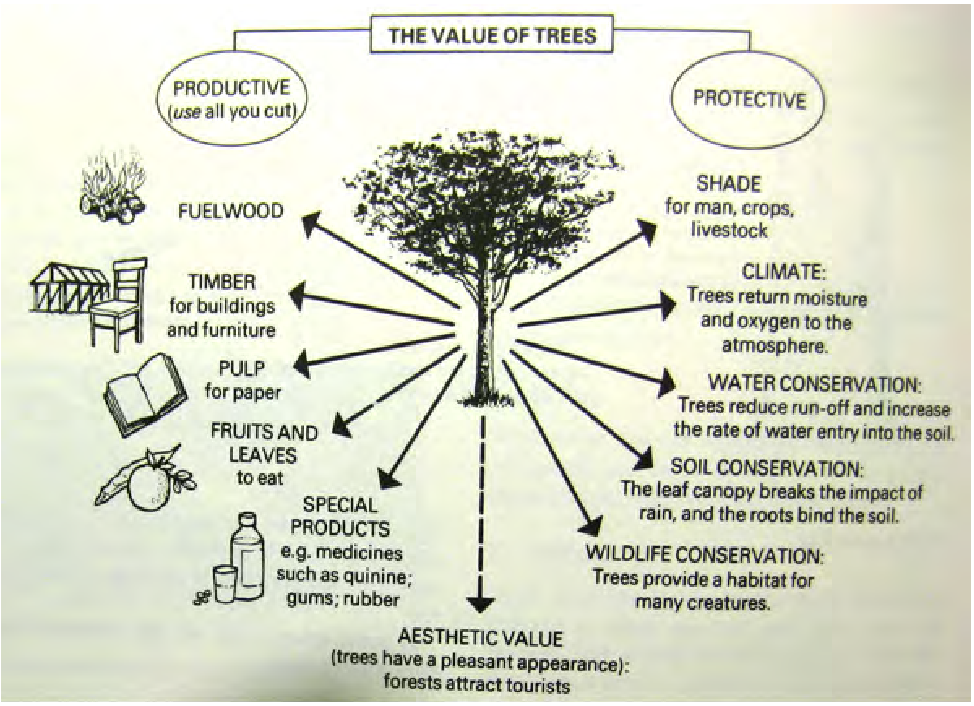

Figure 2. The Value of Trees
Source: Joy & Wibberley, 1979

There is considerable Biblical reference to trees, including several named species, and lessons drawn from them, from which we can derive both spiritual & physical lessons to apply to our lives, land & livelihoods. In the book of Revelation, of all creatures, trees are singled out for protection alongside land and sea (Rev.7:3). In the final chapter of the Bible is the vision of the tree of life bearing twelve fruits in season and having leaves for the 'healing of the nations' (Rev.22:2;14). Substantial healing now is possible using knowledge of the healing properties of various trees (see www.anamed.org). Reasons for growing and nurturing trees are manifold (Wood, Burley, 1991). They can both help halt desertification and also reclaim degraded land. Key productive and protective values of trees are depicted in Fig.2.

3. Resources

The connection between forests, food and people has long been understood (Beresford-Peirse, 1968). Astill (2010) incorporated global climatic considerations into the picture. As cities expand, trees disappear. This is very evident on mountains adjoining Freetown, Sierra Leone.

As for timber, the world's largest exporters are Canada, Sweden and Finland, while by far the largest imports of timber go to China (protecting its own 22 % forest cover), followed by Japan (despite its 68% forest cover) and the UK. Concerning forest loss, African wood removal (Mm^3) totals 712 and is 13.5% of the World's 5259. However, 85-90% of this removal in Africa is as woodfuel while the world average removal as woodfuel is 35% of all. Global Forest Area losses during 1990-2010 were just over 13 Mha (down 0.33%). In Africa, losses were almost 7.5 Mha; S. America was 8.2 Mha down. On the other hand, while Asia lost almost 0.6 Mha from 1990-2000, it gained 2.2 Mha between 2000-2010 (FAO, 2012). Encouragingly too, global designation of forest land for biodiversity conservation increased by 35% to occupy 12% of the world's forests in those 2 decades.

4. Ecology

Humans are an integral part of forest and rural communities. However, indigenous and local communities of Gambella, Ethiopia - 70,000 people in all - are being forcibly relocated to make land available for investment in agriculture. There are plans to relocate an additional 150,000 people, most of whom are subsistence farmers who have been able, until now, to feed their families without receiving government or foreign aid over the last twenty years. (Wibberley, 2011; Oakland Inst. 2012, open letter to US President Obama).

Created in 1959, the African Forestry Wildlife Commission (AFWC) is one of six Regional Forestry Commissions established by FAO to provide a policy and technical forum for countries to discuss and address forest issues on a regional basis. It meets every two years. Nasi & van Vliet (2011) have measured wildlife populations in logging concessions in central Africa in order to monitor and evaluate their biodiversity impacts. The Nyika-Vwaza Trust affords habitat and wildlife protection not only within Malawi but across the border into Zambia. National organisations play a vital role, such as the Wildlife & Environmental Society of Malawi (WESM), as do civil society organisations that have become transnational such as the Green Belt Movement begun in 1977 in Kenya by the late Wangari Maathai (2006; 2007) – though she began with her own small tree nursery in 1974. Engaging local farmers and their management skills is absolutely key.

5. Extension

The principles for extension of tree planting adopted and field tested for four decades by the Green Belt Movement (GBM; Maathai, 2006) are listed in Table 2. GBM bases its work on the following values:- love for environment conservation; self and community empowerment; volunteerism; strong sense of belonging to a community of like-minded people; accountability, transparency, honesty. Groups are crucial (Kyamuwendo, Wibberley, 2011).

From the outset, the GBM tree-planting campaign was linked to food security and water harvesting at household level, civic education, advocacy, Green Belt safaris to gain inspiration from elsewhere, and Pan-African training workshops. Kenya has been well-supplied with information to help appropriate tree-planting there (Teel, 1984; Gammell, 1989). However, GBM results have been spectacular, with well over 30 million trees planted in Kenya alone - a triumph of rural forestation and reforestation. Rural employment has been created and environmental awareness raised. Individuals and communities have been inspired, empowered and mobilised. Biodiversity, a wider range of food crops and water catchments have been protected locally.

Table 2. The Ten-Step GBM Procedure for adoption of Tree-Planting

1. Dissemination of information to communities on tree-planting importance;
2. Facilitation of Group formation in communities;
3. Registration of Groups with GBM HQ;
4. Preparation of Tree Nursery sites by Groups;
5. Reporting monthly by Groups to GBM HQ;
6. Announcement by Groups to communities:-'seedlings ready', inviting interest to dig holes;
7. Checking of tree holes by Group members;
8. Issuing of tree seedlings to those who dug holes properly;
9. Verification of tree seedling survival by Group members, reporting to GBM HQ;
10. Second verification of seedling survival, and purchase of seedlings by GBM if successful.

Source: Maathai, 2006

Women have risen in status through their practice, associated increase in availability of agricultural tools, advocacy and networking via GBM. All this has led to extensive documentation and recognition of GBM internationally. Lessons learned by GBM include:- community felt needs must be addressed; participants must perceive the sense of this work; good leadership is vital; community motivation requires patience and commitment; short-term incentives help poor people to engage with it; both decision-makers and communities need to be reached simultaneously; GBM field staff must be keen observers; communities must understand the project objectives and own it; limited resources demand prioritisation; democratic administration and management is key. The Mission of GBM is '*to mobilise community consciousness for self-determination, equity, improved livelihood securities and environmental conservation using trees as the entry point*' (Maathai, 2006).

There are constraints in promoting tree-planting, such as the taboos on fruit tree planting in northern Ghana where some fear they will die once the trees planted start fruiting. However, there is real pride in tree planting too such that people will hardly destroy trees they have planted themselves. During long dry seasons, many fodder trees are browsed by livestock but few people plant them. Hay for dry season livestock feeding can be made from the foliage of a number of trees including *Bauhinia* species (Neats-foot in RSA) and a range of mulberry trees (*Morus spp*.).

There is a range of tropical leguminous trees and shrubs *Leucaena spp., Gliricidia spp.* ('Mother of Cocoa'), pigeon pea (*Cajanus cajan*) used for alley cropping. *Calliandra calothyrsus* is an excellent fodder tree candidate and also attracts bees for bee-keeping microenterprises (van Houten, 1998; Wambugu, 2002). The challenge is to scale up the use of such species (Wambugu *et al*, 2001). All steps to plant more trees merit consideration since too many households depend on selling charcoal thus further depleting existing tree cover. Adoption of fuel-saving stoves (www.fourthway.co.uk) needs to go alongside tree-planting. These can save as much as 70% of woodfuel compared with typical cooking on three stones.

6. Systems

An agro-ecological approach in which trees, field crops and livestock are integrated is vital for the secure future of farming systems, and for their sustainable intensification (Koohafkan et al, 2011; Wibberley, Turner, 2012). It has long been known that forest resources can improve agriculture (Adeyoju, 1975). Lack of trees leads to farmers using their maize and other stalks as firewood instead of as mulch, which is crucial in conservation farming (Oldreive, 1993; Kassam, 2011). Agroforestry has been practised in various forms for many years (Douglas, Hart,1980; Barnard, 1990). It has been especially advocated for dryland areas (Rocheleau *et al*, 1988) and for soil conservation (Young, 1989; 2010). Carr (2002) charts the limited spread of agroforestry in Malawi, although it is part of the answer to greater soil degradation as population pressure increases in a context where most families lack capital for both yield-enhancing inputs such as fertilisers and for enough of their own animals to produce manures. *Faidherbia albida* is proving successful in Zambia, interplanted at 100 trees per hectare when it can fix up to 300 kg N/hectare (Aagaard, 2011). Its great advantage is that it sheds its leaves at the onset of rains to enrich the soil also removing their shading effect from the associated annual crop. Results can be spectacular with paradoxically greater crop growth under the trees than away from them! Furthermore, its pods and leaves are protein-rich for livestock feeding.

Secure tenure is an important prerequisite for sustainable forest management (Fortmann, Riddell, 1985). More diversified tenure systems could provide a basis for improving forest management and local livelihoods, particularly where the State has insufficient capacity to manage forests. In the past decade many countries have initiated efforts to reform their tenure arrangements for forests and forest land, devolving some degree of access and management from the State to others, mainly households, private companies and communities.

The Forest Stewardship Council (FSC) website (www.foreststewardshipcouncil.org) informs that it "is a global, not-for-profit organisation dedicated to the promotion of responsible forest management worldwide, founded in California in 1990. FSC enables businesses and consumers to make informed choices about the forest products they buy, and creates positive change by engaging the power of market dynamics. FSC facilitates the development of standards, ensures monitoring of certified operations and protects the FSC trademark so consumers can choose products that come from well managed forests. Members include some of the world's leading environmental NGOs (e.g.WWF), businesses (Tetra Pak and Mondi plc) and social organisations (e.g. The National Aboriginal Forestry Association of Canada), as well as forest owners and managers, processing companies and campaigners, and individuals. Together these diverse voices define best practices for forestry to address social and environmental issues. The membership consensus sets the FSC Principles and Criteria - the highest standards of forest management which are environmentally appropriate, socially beneficial and economically viable (Table 3). This diversity is FSC's strength and to make sure no one viewpoint dominates the others, its membership has three chambers – environmental, social and economic – that have equal voices in decision-making, with both global North and South sub-chambers. Rainforest desperately needs protection internationally (HRH The Prince of Wales; McMahon, 2009) including Africa's Congo Basin treasury (Maathai, 2009).

Table 3. FSC Certification, Rules & Guidance

Ten FSC Principles require the forest owner or manager to do the following:
1. Comply with all laws, regulations, treaties, conventions, agreements, & all FSC Criteria;
2. Define, document and legally establish long-term tenure and use rights;
3. Identify and uphold indigenous peoples' rights of ownership and use of land and resources;
4. Maintain or enhance forest workers' and local communities' socio-economic well-being;
5. Maintain or enhance long term economic, social & environmental benefits from the forest;
6. Maintain or restore the ecosystem, its biodiversity, resources and landscapes;
7. Have a management plan, implemented, monitored and documented;
8. Monitoring and assessing to demonstrate progress towards management objectives;
9. Maintain or enhance high conservation value forests & attributes which define such forests;
10. Plan and manage plantations in accordance with FSC Principles and Criteria.

Environmentally appropriate forest management ensures that the harvest of timber and non-timber products maintains the forest's biodiversity, productivity, and ecological processes. Socially beneficial forest management helps both local people and society at large to enjoy long-term benefits and also provides strong incentives to local people to sustain the forest resources and adhere to long-term management plans. Economically viable forest management means that forest operations are structured and managed so as to be sufficiently profitable, without generating financial profit at the expense of the forest resource, the ecosystem, or affected communities. The tension between the need to generate adequate financial returns and the principles of responsible forest operations can be reduced through efforts to market the full range of forest products and services for their best value."

7. Discussion

That trees and forests need management is beyond doubt **(**Blyth *et al*, 1987). Plantations have their place (Evans, 1982) and coppicing can provide regular harvests (Macpherson, 1995). Community forestry can engage all ages of people both in new communal plantations and in managing indigenous ancient forests (Sjöholm, 1989). The human dimensions of deforestation need better understanding and action (Sponsel *et al*, 1996; Scales, 2012). While forest protection is imperative as are reduced emissions from deforestation and desertification (REDD), exclusion of indigenous people from forests for the benefit of tourism and extractive business elites is a travesty. Long-term sustainable management and public enjoyment of forests cannot be attained unless indigenous populations and their livelihoods are recognised and mobilised to care (Ogana, 1990; Thomas, Wibberley, 2001). Those who plant their own trees tend to care for them. The work of the Green Belt Movement is an inspiration (Maathai, 2006). Key factors in the evaluation of afforestation are summarised by SWOT analysis (Strengths; Weaknesses; Opportunities; Threats) in Table 4.

Table 4. Forest SWOT Analysis: some key points

STRENGTHS
• Productive – multiple and diverse products
• Protective – multiple benefits from local to global significance
WEAKNESSES
• Ties up land a long time, so softwood monocultures are too often planted
• Takes some years to reach maturity, especially in cooler areas
OPPORTUNITIES
• Integrated systems – agroforestry, silvo-pastoralism
• Adding value – high value items, tourism, ecosystem payments (REDD etc.)
• Investment for steady profit and environmental gain
THREATS
• Mechanised logging penetration rapidly and deeply into forests
• Cheap 'land grab' leases and sales to foreigners
• Deforestation for annual cropping or ranching feedlots

8. Recommendations

Based on experience of rural community development and field extension work in Africa, it is proposed that fourteen points integrate to promote tree progress for sub-Saharan Africa (Table 5).

Table 5. Proposals for Tree and Forest Promotion

• Teach Bible heritage basis	• Plant/retain riverbank trees
• Lift Environment awareness	• Promote Bee-keeping
• Promote Tree Nurseries	• Livestock control/housing
• Encourage 2-trees/house	• Best home & village competitions
• Promote use of tree guards	• Junior Conservation Clubs
• Fuel-efficient stoves	• Environment Care Groups
• Add value to forest produce	• Churches as Demonstration points

Responses following practical workshops facilitated by the author in four villages in Malawi in 2012 are shown in Table 6. Participants were asked to identify what they had learned or been reminded about during the workshop, with whom they would share this, and what they would do during the next six months with the resources that they control or influence. This is an approach followed internationally by the author with farmers over the past four decades at the conclusion of practical workshops.

Table 6. Responses to Practical Tree Management Workshops

MCHIZANJALA (‘Healing Hunger’): What have you learned/been reminded about? 18 attendees (60% male) • Trees in the Bible (14) • Caring for Trees (14) • Sustainability of Life • Uses of Trees (4) • Use of bamboo as water-pipe or gutter	**MCHIZANJALA**: What will you do in next 6 months? • Teach how to plant & start a Tree Nursery • Start a Tree Nursery & sell seedlings (2) • Plant trees on eroded/erodible land • Expand Conservation Farming • Use tree guards • Build a fuel-saving stove • Help form FARMS Groups • Raise chickens & use their manure to make compost & ‘ring’ trees against termites
KONGWE (‘Cold’): What have you learned/been reminded about? 25 attendees (70% male) - 2 funerals • Why it is bad to destroy trees • Benefits and values of trees • Manure can also come from trees • Fuel-saving stoves • Importance of livestock care • Environment Care goes with spiritual life • Don’t cultivate up to riverbanks • Raised livestock house can be home-made • Leucaena is animal feed (<25% ration) • Bees & Trees benefit each other • Avoid cows & goats eating plastic	**KONGWE**: What will you do in next 6 months? • Plant trees : 10 – 25 each (12 people) • Plant 10 different kinds of tree • Establish a tree nursery (2) • Establish a Conservation Farming plot • Make a fuel-saving stove (5) • Teach how to make fuel saving stoves • Incorporate tree work in Farmers’ Group
KASITU: What have you learned/been reminded about? 44 attendees (55% male, including 8 Chiefs) plus children & others • Uses of trees • How to care for trees • Goodness of fuel-saving stoves • God made us responsible to care • It is good to promote bee-keeping • Recommendations are possible to do • How to care for soil • Animal care and disease reduction	**KASITU**: What will you do in next 6 months? • Build proper housing for goats (7) • Start a tree nursery (20) • Do mulching and Conservation Farming (9) • Make a fuel-saving stove (9) • Establish a personal forest • Establish a Community Forest • Make tree guards (12) • Plant trees either side of the river (5) • Promote & start bee-keeping (20) – firstly in Kumi Lanjujhi village (‘Ten Bees’)
CHILEKA (‘To leave’): What have you learned/been reminded about? 20 attendees (60% male); 2 funerals; • How to care for and protect trees • Spirit of working together • Agroforestry • Trees give us oxygen • How to care for animals • Trees give us food for all • Trees purify air of carbon dioxide • God wants us to care, not destroy creation • Managing trees and animals • Conservation farming • Benefits of fuel-saving stoves • Do not cultivate up to riverbanks	**CHILEKA** : What will you do in next 6 months? • Continue/expand conservation farming (7) • Plant 1 papaya and 1 mango (15) • Dry and preserve mangoes (6) • Make a fuel-saving stove (10) • Plant 20 trees (10 fruit/10 fodder) • Keep pigs in a proper pen • Share with existing farmer groups

Source: Malawi 2012

9. Conclusions

Trees and forests, their planting and protection offer a unifying focus for sustainable rural development. Both locally and globally they link to communal well-being – the Biblical 'tree of life'. Reversal of the alarming scale of tree removal is urgent in many places, especially in sub-Saharan Africa. Integral management involving trees is vital for genuinely sustainable intensification for the rising global population's food security. A global policy framework for forest stewardship must be rigorously applied by each nation. However, only by engaging indigenous people and integrating tree care within their livelihoods can progress be attained.

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SCOPE OF THE FIRM AND MANAGEMENT INFORMATION IN LARGE-SCALE RICE FARMS

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Abstract

Using results of a questionnaire survey of large farms in California, this study investigated the relation between information management and the scope of firms, especially integration into drying and warehousing. First, the majority of large farms are equipped with information communication technologies (ICT) such as global positioning systems (GPS) guidance systems and auto-steering. Integrated farms adopted precision agriculture technologies including Real Time Kinematic (RTK) GPS more than specialist producers did. Secondly, integrated farms accumulate more data related to yield and output inventory. They also provide video instruction and visual manuals for employee education. Farms with hierarchical structures monitor the input inventory and working time more intensively than simple structure farms do. Thirdly, large farms keep a record of input flow and input price. They also acquire information related to output rice quality. Operation schedules are well-planned in large farms. It is noteworthy that no significant adverse relation was observed despite the small sample size. Accordingly, rice farm expansion in the information age is expected in two directions. i) Integration using yield and output stock information to coordinate between upstream and downstream processes. Input inventory and working time should be monitored carefully. Yield monitors, RTK and other ICT will be used intensively to achieve uniform quality over farm fields. Employee education is also enhanced by visual ICT. ii) Scale expansion can be pursued with access to input flow and price information. Rice quality is important because it reflects the sale price to millers. A well-organized operation schedule within the farm is also important to manage farmland expansion geographically. It is noteworthy that integration and farm size are correlated strongly with each other in the California case. Both directions are therefore presumed to proceed simultaneously where land resources are abundant.

Keywords: management information, scope of the firm, integration, rice production, Information Communication Technology (ICT)

1. Introduction

Information management in a firm is regarded as an important factor determining the “scope of a firm” in the theory of organizational economics (Collis and Montgomery, 1998). A main reason for broader scope of operations is to avoid opportunistic behavior attributable to uneven inter-firm distribution of information. If partner firms with dominant information take advantage of such opportunities, then inefficiency will occur throughout an economy. Firms can expand the firm scope (product, integration, and geography) and overcome problems of uneven information distribution.

Adverse effects of intra-firm information related to the scope, in contrast, are agency problems within the firm. Employees with specific knowledge in different departments cannot be motivated and monitored as though they are single entities. Once a firm expands its scope and a hierarchal organization is constructed, costs of transmitting information in the firm increase. Information management and intra-firm communication are therefore key elements determining the scope.

Expanded farm size leads to increased geographical scope. Integration and diversification from agriculture is a common strategy to attain added value or to make efficient use of owned resources. It has been regarded as difficult for rice farming to accumulate information where vast areas of outside space are under control. Modern information communication technologies (ICT) such as remote sensing, global positioning systems (GPS), the Internet, and optical sensors facilitate information management for large farms. However, if farm-specific information is accessible to the public, firms might have little incentive to integrate because market transactions will be more efficient. In short, ICT development has both positive and negative impacts on the scope of the firm. Little related evidence has been presented.

A series of surveys of Internet access by farms was included in the Census of Agriculture, the United States Department of Agriculture (USDA, 2007). Figure 1 and Figure 2 respectively present illustrations of Internet adoption rate by farm size and operator age. A clear relation of technology adoption and size is observed. The adoption rate is fairly low by farm operators younger than 70.

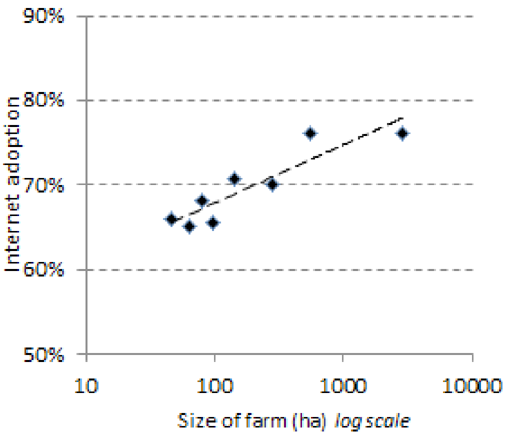

Figure 1. Internet adoption rate by size of farm (California, 2007)
Source: USDA 2007

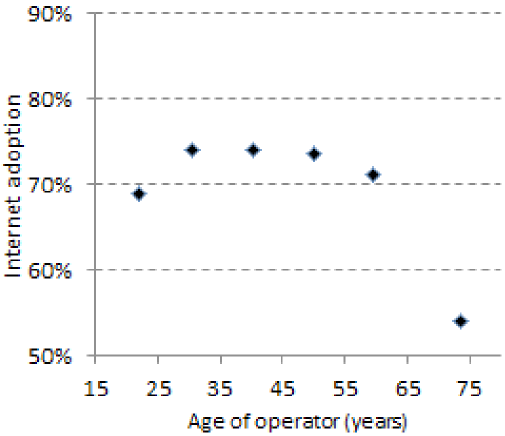

Figure 2. Internet adoption rate by age of operators (California, 2007)
Source: USDA 2007

Earlier studies (Daberkow and McBride, 2003; Banerjee et al., 2008) revealed that younger farm managers who are familiar with personal computers tend to implement precision agriculture (PA) equipment. The farm size, crop yield, and reliance on agricultural income also had a positive impact on the adoption rate. Yagi and Howitt (2010) concluded that the target cost reduction by PA is about 1% for farm managers who used the technology. These studies have particularly addressed the conditions of new technology adoption. Few researchers have examined the relation between the information contents and business attributes of the farm, especially the scope of the firm. Therefore, this paper clarifies i) the present situation of ICT application, ii) information management, and iii) these relations with farm attributes. Our studied case is Californian large-scale rice farms, where ICT has been prevailing dramatically, and where product quality is emphasized.

2. Research framework and methodology

2.1. Framework of managerial information

Figure 3 presents a conceptualized framework of managerial information. Corporate management, in theory, is composed of capital process and production process with capital and product flow. Each process includes stock and flow information. For example, quantity and quality of procured resources are flow information. The inventory is recognized as resource stock information. Resources are combined and transformed into products using technology, which includes information. This production is monitored as production condition information. Efficiency measures of procurement, production, and sales are information used to compare production processes with those of capital in financial terms. Market information and available technologies existing outside the firm can be stored as intra-firm information. This study specifically examines the production process. The use of efficiency information is exempt from the objective of this paper because it is not available to firms until the stock and flow information of production and capital process.

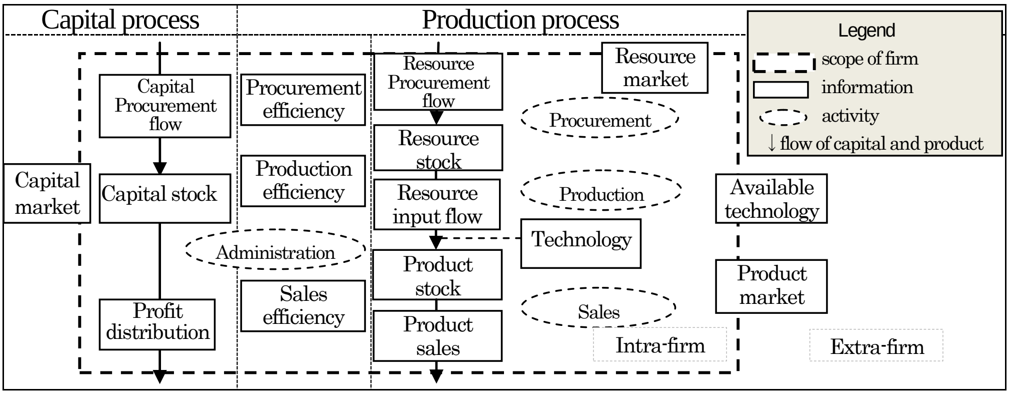

Figure 3. Framework of managerial information

2.2. Research methodology

First, the industrial structure of rice production in California must be overviewed to identify the scope of the firm. For this purpose, interviews of representatives of California Rice Commission (CRC) and the Farmers Rice Cooperative (FRC) were conducted in 2010 and 2011.

Secondly, ICT adoption, management attributes and information management by rice farms are surveyed. Our survey was administered with the support of FRC in August 2012 at the venue of Rice Field Day of the Rice Experiment Station in Biggs, California. The questionnaire sheets were distributed to 49 large-scale rice farm managers. We received 17 responses by postal mail (response rate, 35%). The sample covers some 2.2% of large scale farms with 617 ha (250 acres) and more, although they are few number[1]. The results of the survey conducted in Japan (Nanseki et al., 2013) [2] were compared to ours as well. Analyses specifically examine the circumstances of information management and its relation with firm scope, farm size, and manager attributes.

3. Californian rice industry and rice farms

3.1. Rice industrial structure of rice in california

The current rice industry structure as ascertained through our interviews is presented in Fig. 4. In all, 1,304 rice farms exist, although few farms hold drying facilities. Seventy professional dryers operate warehouses as well, which store dried rough rice until it is shipped to millers. Twelve millers exist, including FRC, some of whom own drying facilities. Only two large-scale rice farms own drying facilities and a mill. Vertical integration from the farmers' perspective is of two types: III) and IV) in Figure 4. A main concern is the impact of information management within these integrated farms compared to that for most specialist producers.

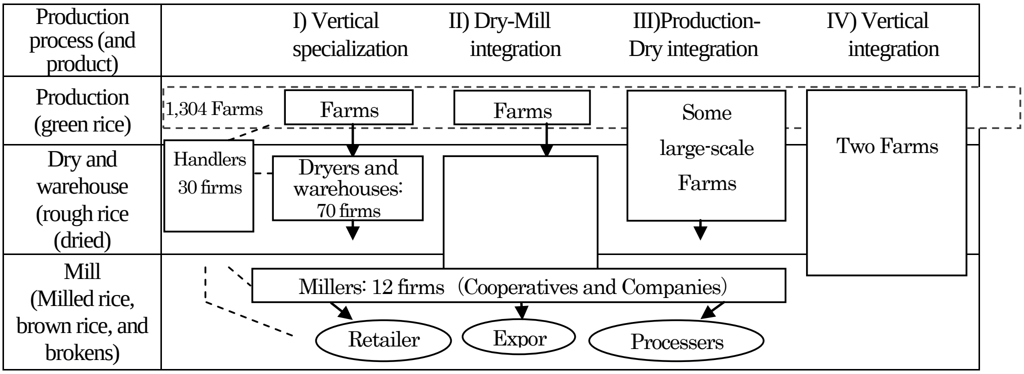

Figure 4. Industrial structure of rice in california
Source: Interviews by authors to representatives of Farmers' Rice Cooperative (FRC) and California Rice Commission (CRC) in 2010 and 2011

3.2. Summary of large-scale rice farms

Table 1 presents a summary of survey results. All farm size attributes are considerably large, reflecting our objective, compared to the state average. Of 17 sample farms, seven (41%) integrate drying and warehousing processes. Such integrated farms are large according to the positive correlation observed (0.64). Seven (41%) farms assign section managers with an average number of 1.00 (managers/farm). Fourteen (82%) farm managers received tertiary education (university or college); seven had majored in agricultural subjects (five in agri-business, two each in agricultural economics and agronomy). The farm manager age is not largely different from the state average.

4. Information management and farm attributes

4.1. Adoption of information equipment

Table 2 shows the observed adoption rate and relation with farm attributes of respondent rice farms. Twelve respondents (71%) are equipped with GPS guidance and auto-steering. Such PA equipment is commonly attached when farm machinery dealers sell tractors or harvesters. About half of respondents use inch-level accuracy Real Time Kinematic (RTK) GPS, an RTK leveler, and GPS yield monitor. One RTK system costs about 250 thousand dollars. Despite that cost, the

Table 1. Summary of Respondent Rice Farms

Item		Surveyed farms	Correlation with area	Compared to rice farm average in California (2007)
Management attributes	Integration (dry and warehouse)	41%	0.64**	–
	Assigning section manager	41%	0.13	–
	Corporation (incl. partnership)	29%	0.25	46.2%
	Number of Section managers	1.00	0.31	–
Farm size	Area of rice planted	635 ha	–	165 ha
	Number of harvesters	2.76	0.77**	0.39[a)]
	Number of employees	8.18	0.92**	2.57[a)]
Farm Manager attributes	Tertiary education	82%	0.15	–
	Majored in agriculture	41%	0.33	–
	Age	54.1 yrs old	–0.32	55.2 yrs old[b)]

State average is based on USDA: a) average of oilseed and serial farms (of which 52% are rice farms); b) average of operators whose prime occupation is farming; ** 1%, * 5%
Source: Questionnaire survey by authors in 2012, August (n = 17)

high adoption rate of RTK monitors and RTK by integrated farms are assumed to represent their need to achieve uniform yield and quality for easier post-harvest handling. Variable rate applicators (VRA) of fertilizer or chemicals and water level monitors are adopted less frequently. No significant relation was found either with farm size or manager attributes.

Table 2. Adoption rate of information equipment and farm attributes

Item	Statistical test	GPS guidance	Auto-steering	RTK	GPS yield monitor	VRA	RTK leveler	Water level monitor
Adoption rate		71%	71%	59%	41%	24%	53%	6%
Integration	Ratio difference	◆	◆		◆		◆	
Assigning Sec. Manager				◆				

Note: n = 17, significance: ◆ 5%; no significant relation was found with type of corporation, number of section managers, farm size variables (area planted, the number of harvesters and employees), or manager attributes (age and education)

4.2. Practice of information management

Results of information management practices are presented in Table 3. Results compared to Japanese rice farms are also provided. More than half of respondent farms store employees' information (address, gender, age and wage), field/farmland information (area, yield, land owner) and rice inventory information in the form of a database. Resource flow (input use and working time) and production conditions (plant and field) are less frequently acquired, probably because of the difficulty in observing real time information.

Integrated farms are more intensively using information related to yield and quantity of rough rice in the storage. They must manage the quantity of green rice and rough rice to coordinate between production, drying and warehouse sections. Specialist farms instead need only carry harvested rice into dryers' facilities and are paid based on the moisture and quantity of rice. Farms with section managers maintain a record of input inventory and working time, probably because of the need to monitor the hierarchical structure in the firm.

Farm size has less relation with information management than the management attributes. Larger-scale farms tend to acquire information of input uses and that of quality of rice. Efficient use of input is emphasized by such farms because the larger the farm is, the more costs it can accommodate. Rice quality is also important because it reflects the price paid by mills. The transaction is made based on "Head and Total" which is the proportion of whole kernels, broken, and other residues.

Managers' objective attributes show little difference in information management. This result matches the census result for Internet access.

Japanese rice farms, from a comparative perspective, practice inventory management, quality of rice, customer information and Internet advertisement more intensively than Californian farms do. Financial management reaches one-ninth of farms. Corporate rice farms in Japan usually operate through production, drying, warehousing, milling, and retailing. Such vertical integration might reflect the importance of intra-firm information management.

Table 3. Information management practice and farm attributes

Item	Test	Resource stock			Resource flow		Production condition		Output, sales and administration					
		managing input inventories	managing employee information	managing field/farmland information	acquiring input use information	acquiring working time information	acquiring plant information	acquiring field information	accruing rice yield	evaluating rice quality	managing inventory information of rough rice in storage	managing customers information	advertisement of product through the internet	managing financial information/ book-keeping
Adoption rate	–	47%	71%	71%	29%	12%	31%	13%	38%	19%	50%	38%	31%	81%
Results in Japan [a]	–	66%	49%	–	–	–	17%	19%	–	30%	–	73%	68%	90%
Integration	Ratio		◆	◆	◆				◆◆		◆◆			◆
Corporation	:												◆	
Sec. Manager	:	◆◆		◆	◆		◆					◆◆		
Number of Sec. Managers	Mean					◆◆								
Area of rice	Mean				◆◆					◆	◆			
Number of harvesters	:													
Number of employees	:				◆					◆				
FM Education	Ratio	◆◆										◆		
FM Agri. Major	:	◆											◆	

Note: All management in electrical basis with PC, etc.; [a] result in Japan refers to a survey in 2011 by Nanseki et al. (2013); 3), significance: ◆5%, ◆◆1%; no negative correlation was found

We also surveyed how frequently each farm updates the information (Table 4). Only two respondents update employees' information weekly, although most farms do so less frequently. Aside from one farm acquiring plant information daily during harvesting season, checking production conditions is not a regular practice for farms.

Table 4. Frequency of information update/acquisition

Frequency	Input inventory	Employee information	Field/ Farmland information	Frequency	Plant information		Field information	
					growing season	harvesting season	growing season	harvesting season
Weekly		2		daily		1		
Monthly	3	2	2	weekly	2	3	1	1
Half-yearly	1	3	3	monthly	1			1
Less frequently than half-yearly	4	4	7	less frequently than monthly	2	1	1	
Total	8	11	12	total	5	5	2	2

Note: n = 17, figures are the quantities of respondents for each item

4.3. Reference of market price

Table 5 presents results for the frequency of reference to market price information. Nearly half of respondents (44%) check rough rice prices weekly; 19% refer to fertilizer/chemical prices weekly. Wages, land rents, and machinery prices are less frequently of concern. Significant positive correlation was found between fertilizer/chemical reference and farm size variables (area, harvester, and employees). This result is consistent with the tendency of input flow information management described in the previous section. It was also observed that younger farm managers and private farms show more concern about the output price.

Table 5. Frequency of reference to market price

	Fertilizer/ chemical price	Machinery price	Wage	Land rent	Interest rate	Rough rice price
Weekly	19%	0%	0%	0%	6%	44%
Monthly	38%	19%	0%	0%	25%	38%
Less frequently than monthly	44%	81%	100%	100%	69%	19%
Correlation with						
Corporation						–0.58*
Area planted	0.57*					
Number of Harvesters	0.69**					
Number of Employees	0.55*					
Age of FM						–0.78**

Note: n = 17, correlation is calculated using codifying as 3 (weekly) to 1(Less frequently than monthly), significance: * 5%, ** 1%

4.4. Intra-firm communication

Finally, the adopted practice of the intra-firm communication is presented in Table 6. Integrated farms provide video instruction to share the operation procedures with employees as well as manuals with photographs and figures. This relation probably reflects the hierarchical roles of employees in integrated farms. Large farms, in contrast, prepare a documented schedule of operation because they should organize well over the wide area of operation. Comparative research in Japan showed that 33% of farms provide documented work instruction and 42% prepare a documented schedule. Such practice is assumed to be necessary for coordinating operations over extremely scattered fields plots as well as integrated processes.

Table 6. Intra-firm communication and farm attributes

Item	Providing documented work instructions to direct employees with PC	Providing documented schedule of operation with PC	Email communi-cation with employees	Providing video instruction to share the operation procedure	Providing operation manuals with photographs/ figures to share the operation procedure
Adoption rate	0%	19%	25%	31%	31%
Result in Japan[a)]	33%	42%	27%	12%	20%
Integration	-			◆	◆
Corporation	-			◆	◆
Area Planted	-	◆ ◆			
Number of Employees	-	◆			
FM Agri. Major	-	◆		◆	◆

Note: Significance: ◆ 5%, ◆◆ 1%, no negative significance was found; same statistical test is applied as Table 3; [a)] Results in Japan refer to a survey in 2011 by Nanseki et al. (2013)

5. Conclusions

This study investigated the relation between information management and scope of the firm, especially integration into drying and warehousing by large-scale rice farms in California. Relations were observed between information management practice and integration. No significant adverse relation was found despite the small sample size.

First, the majority of large-scale farms are equipped with ICT such as GPS guidance and auto-steering. Integrated farms adopt PA technologies including RTK compared to specialist producers.

Secondly, integrated farms more actively seek and accumulate information related to yield and output inventory. They also provide video instruction and visual manuals for employee education. Farms with hierarchical structures monitor the input inventory and working time more earnestly than simply structured farms.

Thirdly, large farms keep a record of input flow and input price. They also acquire information related to output rice quality. Operation schedules are well-planned in large farms as well.

Japanese rice farms, in contrast, emphasize resource stock management, output, sales and administration management. Moreover, they organize documented instructions and schedules. Such management reflects the complex operation and integration from production through retail. ICT equipment, however, is not easily available to farmers.

Accordingly, rice farm growth in the information age is expected in two directions: i) scope expansion (integration) and ii) scale expansion. Integration is proceeded using yield and output stock information to coordinate between upstream and downstream processes. Input inventory and working time should be monitored carefully. Yield monitors, RTK and other ICT will be used intensively to achieve uniform quality over farm fields. Employee education is also enhanced by visualized ICT.

Scale expansion can be pursued with access to input flow and price information. Quality of rice is of great concern because it is reflected in the price sold to millers. Well-organized operation schedules within the farm are also important to manage the farmland spreading out geographically. It is noteworthy that integration and farm size are correlated strongly in the California case. Both directions are presumed to proceed simultaneously where land resources are abundant. If land use is more limited, as it is in Japan and most Asian countries, then intensive information management and downstream integration would be more important.

These research findings are limited by the small sample size. Further qualitative investigations can verify the relations between information management and the scope of the firm in agriculture. Not only integration within the same product but also diversification into other enterprises is an important topic for further research.

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RISK ADJUSTED COST EFFICIENCY INDICES

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Abstract

This paper examines the impact of downside risk on cost efficiency for a sample of farms. Cost efficiency was estimated using traditional input and output measures, and then re-estimated including each farm's downside risk score. Comparisons were made with and without a change in efficiency when each farm's downside risk score was included in the analysis. As expected, downside risk plays an important role in explaining farm inefficiency. Failure to account for downside risk overstates inefficiency, particularly for farms with low downside risk scores.

Keywords: benchmarks, cost efficiency, downside risk

1. Introduction

Cost efficiency indices are used to examine resource use and product mix. Farms that are cost efficient are using the optimal mix of inputs and outputs. Inputs and outputs of inefficient farms are typically compared to the cost efficient farms. Through this process, benchmarks are created and suggestions for improvements on inefficient farms can be made.

Even though risk can have a large impact on decision making, previous literature that adjusts cost efficiency scores for differences in risk among farms is very limited. Only a small handful of studies have examined, risk, risk preferences, or undesirable outputs (Mester, 1996; Chang, 1999; Färe, Grosskopf, and Weber, 2004; Färe and Grosskopf, 2005). These studies focused on banking and environmental issues. None of these studies examined the impact of risk on efficiency scores for a sample of farms.

The primary objective of this paper was to examine the impact of downside risk on cost efficiency for a sample of farms. Cost efficiency for farms with various degrees of downside risk was compared. Cost efficiency indices were also compared across farm size and farm type categories. This paper adds to the existing literature by providing a justification for adjusting cost efficiency scores for risk preferences, illustrating a method to do so, and making comparisons of efficiency scores with and without downside risk.

2. Methods

Various methods can be used to measure cost efficiency. Data envelope analysis (DEA) or the nonparametric approach is used to measure cost efficiency in this paper. DEA is chosen because it does not impose a functional form on the relationship between outputs and inputs, thus mitigating errors associated with imposing an inappropriate model structure (Färe and Grosskopf, 1996; Coelli *et al.*, 2005).

Cost efficiency measures are relative to other farms in the data set. Even though risk often impacts the input and output mix chosen by decision makers (Robison and Barry, 1987), risk is typically not included in efficiency estimates. Inefficiency estimates that do not include risk may overstate the degree of inefficiency exhibited by individual farms, particularly if risk varies substantially among farms. With this in mind, downside risk preferences are included in cost efficiency analysis in this paper to disentangle downside risk and inefficiency.

Cost efficiency (CE) can be determined by dividing the minimum cost under variable returns to scale by the actual cost observed by the farm:

$$(1)\ CE = \frac{c_i' x_i^*}{c_i' x_i}$$

where c is a vector of input prices, x is a vector of input levels used, i signifies the firm of interest, and * indicates the optimal value (Färe, Grosskopf, and Lovell, 1985; Coelli *et al*., 2005).

The denominator in equation (1) is the actual cost for the individual farm, the numerator is determined for each farm using the following linear program:

$$(2)\ \mathrm{Min}_{x^*}\ c_i' x_i^*$$

subject to:

$$x_{11}z_1 + x_{12}z_2 + \cdots + x_{1k}z_k \le x_{1i}^*$$

$$x_{21}z_1 + x_{22}z_2 + \cdots + x_{2k}z_k \le x_{2i}^*$$

$$\dots$$

$$x_{n1}z_1 + x_{n2}z_2 + \cdots + x_{nk}z_k \le x_{ni}^*$$

$$y_{11}z_1 + y_{12}z_2 + \cdots + y_{1k}z_k - y_{1i} \ge 0$$

$$\dots$$

$$y_{m1}z_1 + y_{m2}z_2 + \cdots + y_{mk}z_k - y_{mi} \ge 0$$

$$z_1 + z_2 + \cdots + z_k = 1$$

where c, x, and i are as previously defined; y is a vector of outputs; the subscript k denotes the number of farms; the subscript n is the number of inputs; the subscript m is the number of outputs; $z_k \in \Re^+$, measures the intensity of use of the kth farm's technology; and * indicates the optimal value (Färe, Grosskopf, and Lovell, 1985; Coelli et al., 2005).

Farms with a cost efficiency index of 1 are producing on the production possibility and cost frontiers, and are using the optimal mix of inputs. Inefficient farms have a cost efficiency index between 0 and 1, with a lower index indicating a greater degree of inefficiency.

Cost efficiency indices are first estimated without the inclusion of downside risk. The efficiency scores are then estimated a second time including each farm's downside risk score as a non-discretionary input. A non-discretionary input is equivalent to a "bad output" and represents an input the manager has little to no control over. Therefore, the model is structured to seek a reduction in the inputs over which the manager does have control (Coelli *et al*., 2005). The linear program below illustrates how the minimum cost under variable returns to scale is modified to include a farm's downside risk score:

$$(3)\ \mathrm{Min}_{x^*}\ c_i' x_i^*$$

subject to:

$$x_{11}z_1 + x_{12}z_2 + \cdots + x_{1k}z_k \le x^*_{1i}$$

$$x_{21}z_1 + x_{22}z_2 + \cdots + x_{2k}z_k \le x^*_{2i}$$

$$\cdots$$

$$x_{n1}z_1 + x_{n2}z_2 + \cdots + x_{nk}z_k \le x^*_{ni}$$

$$r_1z_1 + r_2z_2 + \cdots + r_kz_k \le r_i$$

$$y_{11}z_1 + y_{12}z_2 + \cdots + y_{1k}z_k - y_{1i} \ge 0$$

$$\cdots$$

$$y_{m1}z_1 + y_{m2}z_2 + \cdots + y_{mk}z_k - y_{mi} \ge 0$$

$$z_1 + z_2 + \cdots + z_k = 1$$

where *c, x, y, i, k, n, m, **, and z_k are as previously defined; and *r* is a measure of downside risk. Note that the downside risk score is included as an input constraint, but it is not a choice variable in the optimization.

Downside risk typically focuses on the probability of having low outcomes or the magnitude of low outcomes below a target threshold (Barry, 1984; Hardaker *et al.*, 2004). Following Langemeier and Jones (2001), downside risk is defined as the percent of years in which a farm's net farm income does not cover unpaid family and operator labor. For example, a downside risk score of 0.50 would indicate that in 50 percent of the years in the sample, the farm's net farm income was not high enough to cover unpaid family and operator labor.

Cost efficiency with and without risk are computed for each farm using the equations above. Following equation (1), cost efficiency without risk is computed by dividing (2) by actual cost. Cost efficiency with risk is computed by dividing (3) by actual cost.

Cost efficiency with and without risk is compared among farms with different levels of downside risk and among farm size categories. The cost efficient farms are further divided into two categories, farms with no change in cost efficiency with the inclusion of risk and farms with a change in their cost efficiency index with the inclusion of risk, to determine whether farm size, income shares, cost shares, and financial measures vary among farms with and without a change in cost efficiency with the inclusion of downside risk. T-tests are used to determine whether the differences among the two categories are significant.

3. Data

The 649 farms included in this study were members of the Kansas Farm Management Association (KFMA) and had continuous whole-farm data for the 2002 to 2011 period. Efficiency estimates required data on total cost, outputs, inputs, and input prices. Data pertaining to total cost, outputs, and inputs for the 649 farms were obtained from the Kansas Farm Management Association (KFMA) databank. With the exception of the labor input, USDA price indices were used to develop an input price index for each input. The price for labor was obtained from the KFMA databank. Though annual data were available for each farm, ten-year average data were used in this study to reduce the impact of weather in a particular year on efficiency estimates.

Five inputs were used in the analysis: labor, crop input, fuel and utilities, livestock input, and capital. All costs, including those for machinery and land, were annualized. Labor was represented by the number of workers (hired labor, and unpaid family and operator labor) on the farm and labor price was obtained by dividing labor cost by the number of workers. Implicit input quantities for the crop input, fuel and utilities, the livestock input, and capital were computed by dividing the respective inputs costs by USDA input price indices. The crop input consisted of seed; fertilizer; herbicide and insecticide; crop marketing and storage; and crop insurance. Fuel and utilities were comprised of fuel, auto expense, irrigation energy, and utilities. The livestock input included dairy expense; purchased feed; veterinarian expense; and livestock marketing and breeding. The capital input included repairs; machine hire; general farm insurance; property taxes; organization fees, publications, and travel; conservation; interest; cash rent; and interest charge on net worth (Langemeier, 2010).

Outputs included crop and livestock. Implicit crop and livestock quantities were computed by dividing crop income and livestock income by USDA crop price and livestock prices indices for Kansas.

Table 1. Summary Statistics of Sample of Kansas Farms

Item	Units	Average	Standard deviation
Inputs			
Labor	Number od workers	1.38	0.83
Crop	Implicit quantity	139,445	128,919
Fuel and Utilities	Implicit quantity	43,403	46,332
Livestock	Implicit quantity	47,801	173,518
Capital	Implicit quantity	204,818	145,748
Outputs			
Crop	Implicit quantity	505,976	483,287
Livestocks	Implicit quantity	98,473	221,113
Risk measure			
Downside Risk	Percent of years	44.48%	30.09%
Farm characteristics			
Value od Farm Production	Dollars	360,023	308,968
Net Farm Income	Dollars	88,322	94,915
Corn Income	Dollars	74,374	140,558
Grain Sorghum Income	Dollars	21,412	31,711
Hay and Forage Income	Dollars	13,054	34,441
Oilseed Income	Dollars	77,166	93,286
Small Grains Income	Dollars	61,813	69,380
Beef Income	Dollars	73,523	178,913
Dairy Income	Dollars	471	4,972
Swine Income	Dollars	2,147	18,653
Financial measures			
Operating Profit Margin Rate	Ratio in decimal form	0.0629	0.2333
Asset Turnover Ratio	Ratio in decimal form	0.3321	0.2017
Rate of Return on Investment	Ratio in decimal form	0.0307	0.0651

Source: Kansas Farm Management Association Databank, 2012

The summary statistics are presented in table 1. On average, 44 percent of the time the farms' net farm income was not large enough to cover unpaid family and operator labor. The average value of farm production for the sample farms was $360,023. Net farm income averaged $88,322. Though not shown in table 1 the average number of hectares (irrigated crop land, non-irrigated crop land, pasture, and farmstead) was 815 and the average amount of unpaid family and operator labor was $49,879. The largest three sources of crop income were oilseeds (which consisted primarily of soybeans), corn, and small grains (which consisted almost exclusively of wheat). Beef income accounted for almost all of the livestock income. The average profit margin and asset turnover ratios were 0.0629 and 0.3321, respectively. The average rate of return on investment was 0.0307. It is important to note that this rate of return excludes capital gains on land.

4. Results

The average cost efficiency for the 649 farms in this study are included in table 2. The average cost efficiency index without risk was 0.745. With the addition of downside risk, the average cost efficiency index increased to 0.754. Also, the number of farms on the cost frontier (i.e., cost efficiency index of 1) increased from 8 to 23 with the addition of downside risk.

Average cost efficiency decreased as downside risk increased for both the cost efficiency measures with and without risk. Note that less than 10 percent of the farms had either no downside risk or downside risk in all ten years. In other words, it was common to have at least some downside risk. It is clearly evident in table 2 that the difference between cost efficiency with and without downside risk widened as downside risk decreased. There was not a difference in the measures for the farms with downside risk in every year. In contrast, the difference between the two measures for farms with no downside risk averaged 0.028.

Table 2. Average Cost Efficiency Measures for Sample of farms

Item	Without risk	With risk
Efficiency Measures		
Average	0.745	0.754
Standard Deviation	0.109	0.115
Minimum	0.351	0.351
Number Equal to One	8	23
Downside Risk – number of Years		
0 Years (51 farms)	0.828	0.856
1 to 3 Years (238 farms)	0.797	0.808
4 to 6 Years (181 farms)	0.729	0.739
7 to 9 Years (131 farms)	0.679	0.682
10 Years (48 farms)	0.634	0.634
Farm size – Value of Farm Production		
Less than $100,00	0.678	0.697
$100,000 to $249,999	0.711	0.723
$250,000 to $499,999	0.768	0.773
$500,000 or More	0.796	0.803

Table 3. Average Farm Characteristics by Cost Efficiency

Item	No change with risk	Change with risk	Significant
Number of Farms	245	404	
Efficiency Measures			
Cost Efficiency without Risk	0.714	0.763	Yes
Cost Efficiency with Risk	0.714	0.779	Yes
Risk Measure			
Downside Risk	59.67%	35.27%	Yes
Farm Size			
Value of Farm Production	$432,959	$315,792	Yes
Net Farm Income	$85,818	$89,841	No
Income Source			
Percent of VFP from Corn Income	13.88%	15.94%	No
Percent of VFP from Grain Sorghum Income	5.49%	7.47%	Yes
Percent of VFP from Hay and Forage Income	5.03%	3.49%	Yes
Percent of VFP from Oilseed Income	17.29%	22.51%	Yes
Percent of VFP from Small Grain Income	19.10%	18.85%	No
Percent of VFP from Beef Income	30.51%	19.31%	Yes
Percent of VFP from Dairy Income	0.25%	0.10%	No
Percent of VFP from Swine Income	0.74%	0.49%	No
Cost Share			
Percent of Input Cost from Labor	17.79%	17.01%	No
Percent of Input Cost from Crop Input	22.69%	24.81%	Yes
Percent of Input Cost from Fuel and Utilities	6.99%	6.50%	Yes
Percent of Input Cost from Livestock Inputs	8.21%	4.20%	Yes
Percent of Input Cost from Capital	44.32%	47.48%	Yes
Financial Measures			
Operating Profit Margin Ratio	-0.0333	0.1212	Yes
Asset Turnover Ratio	0.3543	0.3187	Yes
Rate of Return on Investment	0.0084	0.0441	Yes

Cost efficiency with and without downside risk is also summarized by farm size category in table 2. Differences in efficiency between the two cost efficiency measures were largest for the farms in the smallest farm size category and smallest for the farms in the largest farm size category.

To further understand the impact of the inclusion of downside risk, the farms were divided into two categories based on whether the farms experienced a change in cost efficiency with the inclusion of downside risk. Table 3 provides the characteristics of the 245 farms with no change in efficiency and the 404 farms with a change in efficiency. The change in efficiency for the 404 farms ranged from a very small change (0.001) to a change of 0.254. On average, the farms that experienced a change in their efficiency score had less downside risk; were smaller; had a higher proportion of income from grain sorghum and oilseeds; a lower proportion of income from hay and forage, and beef; higher cost shares for the crop input and capital; lower cost shares for fuel and utilities and the livestock input; and had a higher rate of return on investment.

5. Conclusions

Cost efficiency with and without the inclusion of downside risk was estimated for 649 Kansas Farm Management Association farms with continuous data for the 2002 to 2011 period. Outputs included crop and livestock. Inputs included labor, crop input, fuel and utilities, livestock input, and capital. Downside risk was measured as the percentage of years in which a farm's net farm income did not cover unpaid family and operator labor. The average cost efficiency for the 649 farms was 0.745 and increased to 0.754 with the inclusion of downside risk.

The largest increase in cost efficiency with the inclusion of downside risk was for the farms with lower levels of downside risk. In contrast, the increases for farms with high levels of downside risk were negligible. This suggests that excluding downside risk overstated the relative inefficiency of the farms with low levels of downside risk and understated the relative inefficiency of farms with high levels of downside risk.

Cost efficiency differences among the farms with no change in efficiency and a change in efficiency with the inclusion of downside risk varied by farm size and type. Farms with a change in cost efficiency were smaller. These farms also had a lower proportion of their income coming from beef and a higher proportion of their income coming from grain sorghum and oilseed.

In conclusion, including downside risk had a significant impact on relative cost efficiency measures. Thus, traditional efficiency measures that exclude risk may provide inaccurate benchmarks, particularly for farms with low levels of downside risk.

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FARM INCOME RISK ANALYSIS AT THE SECTOR LEVEL

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Abstract

Macroeconomic developments on international agricultural commodities' markets have in recent years considerably amplified interest of income risk management in agriculture. In EU countries this is also new prospective of further agricultural policy development. Therefore, there is a need for empirical analysis and tools aimed at providing in depth insight into the topic. For preliminary decisions and for efficient and effective agricultural policy planning, magnitude and characteristics of income risk that agricultural holdings face, have to be analysed from different viewpoints. Indirect income risk analyses demands high quality microeconomic data at farm level, which are in most cases not available. This paper presents possible theoretical approach how different sources of data at farm level, national statistics and analytical models could be merged and utilised in simulation process to analyse income losses at the sector level. It is grounded on production structure resumed out of annual subsidy applications as key information per each agricultural holding. Presented approach's utilises potential of random number generator and random distributions of Monte Carlo to roughly reconstruct different sources of risks in different states of nature that may occur with diverse probabilities at the particular farm. In such a manner income situation at the farm level is analysed. The developed approach is tested on dairy farms in Slovenia. Obtained results suggest that this could be useful approach for rough estimation of income risk and points on some limitations and drawbacks that could be further improved.

Keywords: risk, income losses, simulation, agriculture, MCS

1. Introduction

In recent years high volatility on agricultural markets parallel with global financial crisis has amplified interest in risk management in agriculture; particularly income risk. Risk management has become also a major policy issue of on-going agriculture policy reforms in OECD and also non-OECD countries (OECD, 2011), since whole-farm income is the best measure of the welfare of agricultural holdings. Stabilizing whole farm income therefore appeals to policy makers (Meuwissen et al. 2011). In many countries this intention has hit on the problem of insufficient data sets for this purpose, especially for analyses of holistic risk management approach. Namely, risk management at the level of agricultural holding is very demanding from information viewpoint (Anton et al., 2011). It requires utilisation of all available information about different risk sources at the level of each particular agricultural holding. The availability of historical farm level data is a major constraint in the analysis of the risk exposure of individual farms (OECD, 2011). Beside farm level microeconomic data, it is also important to have reliable information regarding market developments (Tangermann, 2011).

Lack of fact-based knowledge about risk at the individual agricultural level could be significant problem in changing agricultural policies where risk management is becoming an important issue. OECD (2011, 22) is stressing that this might represent additional source of uncertainty perceived by farmers. Namely, risk assessment is a necessary first step to develop a good risk management strategy (OECD, 2011). Simulation approach presented in this paper aims to support studying income risk at the sector or regional level.

Farms face different varieties of risks that directly influence their income. Agriculture output variability is tightly connected with natural hazards and consequently also with large price fluctuations, both specific for agriculture (Tangermann, 2011). Agricultural holdings can however also benefit from some correlations in managing their risk, as for example imperfect correlation between yields and negative correlation between prices and yields (OECD, 2011). But even if - on average - market mechanism reduces total variability, this does not necessarily apply to each individual agricultural holding (Tangermann, 2011). Namely, volatile prices most often reflect situation on international markets and have small correlation with domestic output variation. Similarly holds for variation in production output that most often affects a group of agricultural holdings, except if risk caused this is systemic. Either outlined facts hold also for farmers in Slovenia, regarding the influence on the market prices. Additional volatility enters through risks arising from other economic sectors. Such an example are energy-intensive inputs' prices (Tangermann, 2011).

First condition to conduct income risk analysis is series of appropriate data. The most appropriate data for this purpose is very accurate accounting system linked with other databases with enough long data series (Anton et al., 2011). In the literature one can find many examples how FADN data could be applied to analyse income risk and efficiency of income risk management. Such examples are Vrolijk and Poppe (2008), Severini and Cortignani (2011); OECD (2011); Majewski et al. (2007). However, even though FADN data are appropriate for such analysis, problem might arise if the data quality is not appropriate or if the sample of agricultural holdings is not adequate to systematically cover the whole agricultural sector. Issue might be also changing sample of agricultural holdings. Common approach in such type of analysis is extrapolation of results from the sample of agricultural holdings to the whole sector. To gain additional information by analysing income issue, this paper suggests opposite approach, designed on including different data sources for majority of agricultural holdings with few or no micro-economic data.

Paper presents theoretical simulation approach how analyses of income risk at the level of agricultural holdings could be conducted without appropriate microeconomic data per each farm, but on the basis of actual production structure and characteristics of income distributions based on national data set and expert judgement. Aim is to get rough estimation of income risk of whole agriculture and of individual sectors. Beside different methodological concept we are mainly interested in analysing characteristics of income risk. Through basic statistics such as measures of central tendency and variation considering confidence intervals, risk measures and quintile measures, better insight into the analysed problem is given. However, it has to be noted that individual risk environment faced by particular agricultural holding can significantly differ from sectoral or aggregate risk (Kobzar, 2006; OECD, 2011). Consequently, suggested approach is not appropriate for in-depth analysis of income risk at particular agricultural holding.

Monte Carlo simulation (MCS) proves as a powerful method for conducting quantitative risk analysis. Approach of random sampling is especially beneficial when there are several sources of uncertainty that interact in the calculated outcome - income in our example. Main idea is that uncertain variables, represented as random number generators (RNG), return sample value from a predefined distribution of possible values for each uncertain variable in each replication of the model. In literature one could find numerous examples how potential of RNG has been utilised for risk analyses in the field of agriculture. For example Kimura and Anton (2011) utilized Monte Carlo simulation to analyse the effectiveness and efficiency of farm income stabilisation programs in Canada using AgriStability payments. Majewski et al. (2007) have utilised MCS method in a static simulation model to estimate the level of volatility of farm incomes on six most often production type in Poland. Anton et al. (2011) utilised MCS to model a farm producing multiple crops under different uncertainties.

Based on this background, the aim of our paper is to present a theoretical bottom up approach how income risk could be analysed on different levels of sector, economic groups of agricultural holdings. Paper presents development of a preliminary attempt to assess the soundness and applicability of the proposed simulation tool. It has been tested on Slovenian dairy farms to consider its strengths and weaknesses and to identify further needs of improvement.

The paper continues with concise description of applied approach and developed simulation tool. It is followed by in-depth description of setting uncertain variables as well as basic characteristics of the data-base. The contribution concludes by obtained results and discussion.

2. Material and methods

2.1. Database

Main information of particular agricultural holding's characteristic are annual data collected by Slovenian Payment Agency regarding subsidy applications (IACS). For the purpose of this study we considered data for CAP 1st pillar payments and also for LFA payments. Benefit of this approach is that we can analyse all farms applying for subsidies regardless if they practice accounting or not. Consequently almost all agricultural holdings in the sector could be analysed with suggested approach.

From IACS database it is possible to gather information about physical production structure for each particular agricultural holding in given period. In the current tool we considered data for the 'subsidy' years 2010 and 2011.

In this way we get some information about all agricultural holdings in particular agricultural sector, however without necessary micro-economic data (like from accounting) for proper analysis of income risk. This is also the main disadvantage of applied approach. Therefore the main challenge was to estimate achieved revenues, gross margins and incomes per each agricultural holding. And even bigger issue was to imitate income risk. Further we present possible conceptual approach how to merge different data sources to mitigate this challenge.

In the first step standard outputs (SO[1]) for all activities included into the model have been defined. For this purpose we considered values already calculated for another study that utilised the same source of data (Rednak, 2012). SO per activities were calculated based on the average data for the period 2005-2009, derived from internal data sources prepared by Agricultural Institute of Slovenia. Further SO at the level of agricultural holding has been calculated based on methodology proposed by European Commission (Rednak, 2012).

In the database 59,632 agricultural holdings are included, divided into 22 farm types. For the purpose of this study and to demonstrate developed approach we will focus just on dairy farms. In this group we got 5,909 agricultural holdings. Further these farms are divided into 11 economic classes that are classified regarding to achieved whole farm SO.

Main disadvantage of this approach for risk analysis is that for all analysed farms in the model the same average productivity and average market prices are considered. To decrease the influence of this mistake, additional indices to adjust SO for crucial activities have been calculated. Such an example is SO for milking cows that is corrected for deviation from average milk production in lactation and average milk production by farm (calculated as farm milk quota divided by the numbers of dairy cows in the herd). Similarly SOs have been corrected for crop activities. In this

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1 The standard output of agricultural production means the monetary value of output corresponding to the average situation (average values over a reference period).

case we have considered that total arable land that agricultural holding possesses could influence the efficiency of production. Smaller plots of arable land per farm (smaller than the average national production significant for particular sector) result also in lower SO and vice versa. In both examples five different indices were considered, ranging from -15 to +15 %.

To get total average revenues per agricultural holdings, SOs were increased for eligible subsidies from the first and second pillar of the CAP. Since most subsidies are decoupled it was not possible to directly estimate revenues per activity. This was considered also by defining costs. Namely, variable cost and fixed costs are calculated in the model as a relative share of SO per each activity. This share has been denoted on historical data set prepared by analytical Model calculations (AIS, 2013).

2.2. Developed tool and simulation model

The main challenge was to estimate income risk for all agricultural holdings in analysed sector. To assess the effect of different normal and catastrophic risks that holdings might face by farming, we developed a complex simulation toll reflecting income loss at whole-farm level.

Simulation tool has been developed in a spreadsheet platform using MS Excel and Visual Basic. To run simulations, additional professional simulation software package, Risk Solver Platform V 10.5.0.0 (RSP) from Frontline Systems has been applied. Beside advanced methods to perform simulations, it enables sensitivity analysis and parameterized simulations, creating a wide range of statistics and risk measures. Simulation is performed based on MCS that are often applied for studying different systems involving uncertainty. It relays on random sampling of values for specified uncertain variables included into simulation model, based on Latin Hypercube sampling.

Simulation tool is organised as mathematical model. It covers 40 different basic activities including livestock, crop production, forage, vegetable and fruit production. With additional static indices (e_i) calibrating baseline activities' SOs, the number of activities further increases (e.g. instead of 1 dairy production activity the model includes 5 different technologies).

So far static economic results per agricultural holding are considered. For risk analysis this is not enough, since one is interesting also in possible deviations from expected revenues, gross margins and incomes within different states of nature. This uncertainty was included through additional random variables, based on frequency distributions analysis, representing possible states of nature for SOs and variable costs. Namely, simulations require probability distributions for their uncertain inputs, from where the simulation model randomly selects sample values.

Regarding the fact that this is preliminary version of the tool and to keep it at this development stage simple, for all uncertain variables addressing farming activities, common triangular uncertain distribution is considered. It is defined by minimum (X), maximum (Z) and most likely (y) values. Set of deflated historical data (AIS, 2013) were analysed to determine how SOs and variable costs for each activity change within the time.

Simulation model simulating achieved income (I) per agricultural holding (f) in different states of nature (j), could be defined as follows:

$$I_{f_j} = GM_{f_j} - FC_f$$

$$GM_{f_j} = \sum_{i=1}^{n} GM_{ij} + SUB$$

$$GM_{ij} = SO_i e_i a_{i_s j} - SO_i * P * b_{i_{ss} j}$$

$$a_{i_s} = Triangular(x_{i_s}, y_{i_s}, z_{i_s})$$

$$b_{i_{ss}} = Triangular(cx_{i_{ss}}, cy_{i_{ss}}, cz_{i_{ss}})$$

$$s = Binominal(s_1, s_2, s_3; p_{s1}, p_{s2}, p_{s3})$$

$$ss = Binominal(ss_1, ss_2; p_{ss1}, p_{ss2})$$

Where FC_f is presumed to be fixed without change in different states of nature. GM_{fj} represents the total gross margin achieved at the level of agricultural holding, which is the sum of all n activities gross margins GM_{fj} that agricultural holding operates, with different values between states of nature j. SUB includes all subsidies from the first pillar including historical payments as well as LFA payments. All subsidies are presumed to remain unchanged within simulation process. a_{is} is index generated from triangular distribution to adjust SO_i, of activity i, per each state of nature j in respect to selected scenario s. e_i is static coefficient to adjust average SO_i of activity to particular farm characteristics (e.g. milk production). Variable cost is calculated as percentage P of SO_i and $b_{i_{ss}j}$ is index generated from triangular distribution to adjust variable cost per each state of nature, regarding the selected scenario (ss).

Within simulation process, different scenario representing different level and type of risks (normal/catastrophic, correlated/uncorrelated, systemic etc.) at the level of SOs and variable costs are presumed. Two uncertain variables (and) are plugged into the model to randomly select scenario which is in place in particular state of nature for SO and variable costs per analysed agricultural holding. Common binominal distribution was assumed in both cases with defined probabilities of occurrence. Consequently five uncertain coefficients were defined for each parameter of activities' triangular distribution in the model: three different for SO scenarios (s) and two different for variable costs scenarios (ss).

First scenarios in both cases include 'normal risk' or most likely deviations. This means that minimum and maximum values are in the range of 'normal' ten years period. Second scenario was defined only for SO and includes greater possibilities for extremes (positive correlation between risks) from first scenario and the range of possible outcomes (min and max) is widened. The third scenario of SO and second scenario for random variable costs anticipates catastrophic or extreme events, with significantly high frequencies of very bad as well as very good outcomes. In most cases this means that outcome could be also zero or something close to zero, less likely it is that outcome would be something very good. Just vice versa holds for logic in defining uncertain indices for variable costs. Which scenario is selected in a particular state of nature depends on discrete uncertain variable, based on binominal distribution.

In proposed analysis simulation includes 10,000 states of nature, which means that outputs per each activity and agricultural holding was calculated for 10,000 randomly sampled values.

3. Results

Even though the main focus of this paper is description of developed tool, an example of possible analysis it enables is presented. For in-depth analyses of income risk different statistical functions are included. Through PSI (Polymorphic Spreadsheet Interpreter) functions of RSP, it is enabled to follow basic statistics for all simulation runs per each of analysed agricultural holding.

In this paper aggregated results for whole dairy sector and one frequency chart for a farm with SO between 15.000 and 25,000 € are presented.

Since simulation always yields whole range of possible outcomes, it is very important how results are analysed and interpreted. In developed tool in-depth analysis of this viewpoint is conducted. In the first step measures of central tendency as mean, median and mode for expected income are calculated. Additional information for each analysed farm has been calculated also with quintile measures such as percentiles, cumulative targets, value at risk (VaR) and conditional value at risk (CVaR). In Table 1 few of these results at the level of different SO groups of dairy farms are presented.

Table 1. Income risk characteristics for dairy farms

SO	Farms	Income				Income loss (> 30%)				Indemnity	VaR 90%
	No.	avg.	min.	max.	SD	avg.	min.	max.	SD	(70% of total)	avg.
1,000 €		1,000 €				%				€	€
4	11	0.4	-0.4	1.1	0.4	26.8	13.4	60.7	13.5	784	803
8	105	1.1	-0.7	2.9	0.8	22.4	8.1	57.2	9.5	11535	1777
15	548	1.9	-1.0	5.7	1.3	23.2	9.1	52.7	8.6	137649	3192
25	1,210	3.2	-2.1	8.4	2.0	23.8	9.5	53.1	8.1	546098	5329
50	2,248	5.9	-4.4	25.8	3.6	23.7	7.3	57.7	7.5	1941991	10068
100	1,328	12.5	-3.2	53.5	6.3	22.8	5.3	47.2	6.7	2287114	20735
250	435	28.0	-3.9	71.4	13.9	22.0	11.6	45.5	6.3	1293260	45506
500	18	62.5	9.3	97.7	22.8	21.2	13.0	36.5	6.4	129498	100749
750	2	131.5	124.4	138.6	10.1	18.9	18.6	19.1	0.4	0	205264
3000	3	515.0	421.4	565.7	81.2	17.3	15.3	19.3	2.0	0	759305

As it could be noticed from Table 1 in all groups of farms, relatively large variation in income within groups is observed. This especially holds for groups with lower SO, where variation between farms is larger. The main part in the sample present farms with SO between 25,000 € and 100,000 €. As it could be observed from table 1 in most groups of farms, losses of income greater than 30% (regarding the current prepositions) occur only between 17.3 and 26.8% of states of nature. So probabilities are relatively low, especially regarding to other analysed sectors not presented in this paper. Of course this is average per group. Higher volatility is observed within groups, particularly those with lower SO. However it is apparent from the Table 1 that extremely low probabilities occur in the last two groups.

By testing developed approach we have estimated also hypothetical indemnities. In the case that income loss is greater than 30% of average income, 70% of producer total income loss is compensated. Calculated indemnity in Table 1 presents sum for all farms in a group. For each particular agricultural holding all possible states of nature (10,000) imitating possible situations are considered. We presumed that only probabilities with occurrence higher than 20% are considered. This means that we are interesting when trigger for indemnities is reached in each particular state of nature. In 80% of them indemnity would be equal or lower. As it is apparent from Table 1 for last two groups such losses occur on max with probability 19.3% and therefore no indemnities are in place.

Indemnities presented in Table 1 are calculated per group of farms and within a sector. However, it could be expected that total indemnities will be lower than calculated per groups as well as per sector (approx. 6,3 million €). This holds especially if we consider that in analysed case no condition was set when farms could participate in such a scheme. Total indemnity obtained assumes that all farms experiencing income loss greater than 30% would participate, regardless of their average income. This is definitely not the case in practice. If we increase minimum level of income as one of possible parameters that influence farmer's decision, total indemnity rapidly decreases.

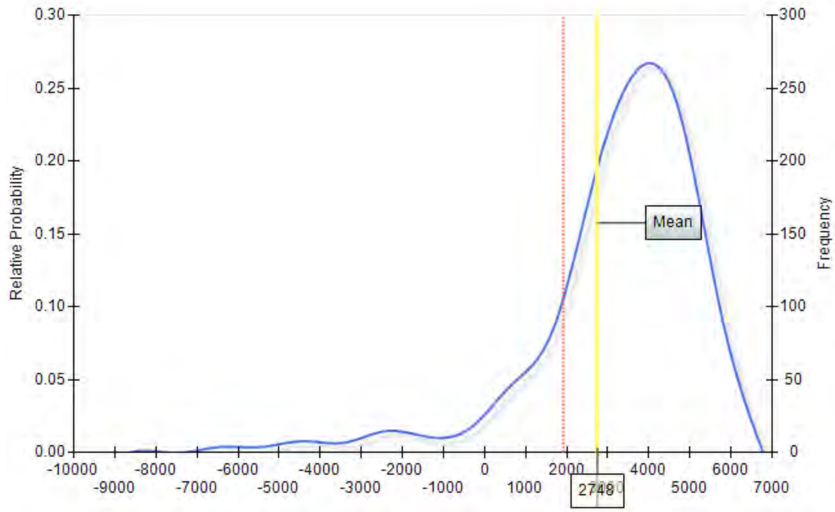

Figure 1. Frequency chart presenting mean income and threshold level for income losses greater than 30%

Figure 1 presents frequency chart for a selected agricultural holding from a sample of dairy farms. Resulted fluctuation exhibit a typical asymmetric feature, where frequent variations around the mean are interrupted by occasional spikes in the tail of distribution. This is due to the fact that some extreme negative occasions might occur with significant positive correlation. Similar pattern could be observed in most analysed examples.

4. Discussion and conclusions

The focus of this study was to present conceptual approach of systematic income risk analysis for different groups of agricultural holdings in a region with bottom up approach. Complex simulation model is applied to analyse individual farm risk income situation with respect to production plan information, based on subsidy applications. Applied approach proves useful, since with simulations and analysing the results one can better understand income issues at the farm group or sector level.

Developed tool has several limitations. Approach how standard outputs and gross margins per activities and per agricultural holdings were estimated is the critical component at the moment. In further development it is necessary to put more focus in this part. Where possible it is necessary to include additional information from other available data sources at micro level. FADN data per different groups and types of farms could be analysed and information could be included as calibration index in the tool. In such a manner for different groups of agricultural holdings as well as for activities more precise random distributions could be defined. In further research also more stress should be put to define more sophisticated distributions for uncertain variables in the model. Where microeconomic data would be available, they should be included through empirical distributions. For other uncertain variables more attention should be put to define more sophisticated functions of random distributions.

Described approach could give enough reliable rough estimate of income risk at a group of agricultural holdings (e.g. sector level, group of agricultural holdings with similar economic size etc.). It seems that with further suggested developments this could be promising holistic approach to give additional information about income risk exposure at the farm level.

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REQUIREMENTS FOR FEEDLOT SITE SELECTION

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Abstract

A large variety of feedlots can be found throughout the country (SA), but locations differ for various reasons. According to the theory, the location decision for a start-up venture is a time-consuming exercise and the following seven factors or conditions need to be part of the consideration (Wickham, 2004): The business environment conditions, availability of resources like water, power and other municipal services, site availability and cost of the services, government (local, provincial and national) regulations and other legislation, availability of markets, and personal preferences in terms of what the role players want, can also influence such decision. Because each of the mentioned factors can comprise many smaller components, and assuming that there is no specific indication methods to be used to compare different localities with each other to make the best location decision, the authors had to find a scientific way to incorporate all the abovementioned as well as other practical aspects and still consider apples with apples to find the optimum location. The specific study area for this research is the former homeland of Transkei which forms part of the Eastern Cape Province of South Africa. The region consists of four different municipality boundaries and in order to set up a decision matrix for each region, data were used from secondary data sources. To compare the different locations with each other a SWOT analysis was done by using weights describing the importance of each element and a score to rate each element. This was done to quantify the results from the SWOT analysis. The analysis was divided into two parts, namely to identify the Strengths and Weaknesses and the Opportunities and Threats. Every factor in the analysis was judged based on the information obtained from the situational analysis. After identifying the most suitable macro area, more or less the same method was used to determine the micro environment, except that the various stakeholders of the feedlot took part in this process. The methodology used in the workshop to develop the strategies, is based on the balance scorecard theory namely Logical Framework Analysis. Objectives and action plans were developed in order to do effective planning of the establishment of the feedlot in a specific micro area.

Keywords: site selection, feedlot

1. Introduction

A feedlot is an enclosure (confinement, pen or kraal) in which underweight animals are kept and provided with adequate amounts of feed and water until they reach the market-ready weight for slaughtering. The main purpose of a feedlot is to achieve maximum growth (average daily gain) with minimum costs (good feed conversion ratio). This is achieved by getting the feed intake as high as possible through the constant provision of good quality feed.

A large variety of feedlots can be found throughout the country (SA). It ranges from small farm feedlots where the farmer feeds 5 – 30 lambs or cattle weaners at a time, to large commercial feedlots with standings of up to 125 000 cattle at a time.

To successfully keep this high concentration of animals on a relatively small piece of land there are several requirements that must be met. It is thus of great importance to ensure that the correct building site is chosen, that already meet most of the requirements, so that no unexpected problems could occur later on. The theoretical background for locating the ideal site for a feedlot business is to be discussed next.

2. The theoretical basis of a location plan

Similar to choosing a form of ownership and selecting particular sources of financing, the location decision has far-reaching and often long-lasting effects on a company's future (Zimmerer and Scarborough, 2005). One set of components that is very important and needs some research and good consideration refers to the location factors. The location decision for a start-up venture is a time-consuming exercise. Regardless of how the decision is made, all location intentions should be considered and described in detail to make a final decision for the final location (Longenecker *et al*, 2012). Because of the huge effort going into the final location decision, it can be helpful to make use of a condensed scientific method to help in identifying the best location for a specific business in a specific industry. According to the theory, there are many aspects to take into consideration in locating a start-up brick-and-mortar business. The choice of a good location is much more vital to some businesses than to others. For the start-up of a cattle feedlot, the traditional physical infrastructure is vital for various reasons. The importance of the initial decision as to where a traditional physical infrastructure like a feedlot must be established is underscored by both the high cost of such infrastructure and the hassle of pulling up stakes and moving such infrastructure.

The following are the key factors in selecting a good location. According to the theory, there are normally five key factors guiding the location selection process. For an industrial company, under which a feedlot can also be classified, there are seven factors, namely:

1. Accessibility of the location that includes transport routes, transport availability, accessible to customers and suppliers. In the case of a feedlot, accessibility for the delivery of the weaners and the fetching of the abattoir-ready cattle is important (Arias and Mader, 2012).
2. Business environment conditions that can also include circumstances. General environmental conditions that need to be considered are weather, competition, legal requirements, enterprise zoning, restrictions around environmental aspects, etc. (Wickham, 2004). Circumstances can also include some political, socio-economic aspects etc. like in the case of the feedlot,
3. Availability of resources like water, power and other municipal services. Large factories, for example steel factories, need large amounts of water for the cooling process while aluminium needs large amounts of electricity to be fabricated, and therefore must be close to a good source. Necessary resources imperative for a successful feedlot are enough water, electricity, labour and the food for the correct balanced supply.
4. Site availability and cost of the services, etc.: Once the role players settled on a certain area of the country, a specific site must still be chosen. The availability of potential sites must then be researched in detail before a final decision can be reached. Costs of the site can comprise many different components that include capital costs as well as the cost of the delivery of services to the specific site (Wickham, 2004).
5. Government (local, provincial and national) regulations and other legislation can have some direct and indirect influences on a specific area and site. Direct influences – government encourages investment by offering advantages like grants or location benefits in the form of low taxes, cheap land, etc. Indirect influences can be, for example, improving infrastructure that will attract businesses.

6. Availability of markets like ease of creating, delivering and satisfying markets is important. A company will not locate near its markets in two cases: the first one is when the market comprises a large area and the second case is where location is more important. In the case of the feedlot, the market is an abattoir where the cattle can be slaughtered.
7. Personal preferences in terms of what the role players want can also have an influence. In the case of a feedlot, this preference should be one of the last aspects to consider because all the other mentioned factors play a more important role. (Longenecker, et al. 2006).

3. Evaluation of all factors for location option

In the previous paragraphs all the different factors that can influence the location decision were mentioned. From a practical viewpoint, to be more accurate, every company must ensure the different factors were evaluated in a specific scientific way to take the real situation and the general needs of the stakeholders into account. (Arias and Mader, 2012)

In the theory there is no specific indication of methods to be used to compare different localities with each other to make the best location decision. For some businesses it can be an easier task just by comparing some factors with each other, to find a good location. For a feedlot it is more complicated to reach a location decision because there are many more detail factors within the seven mentioned categories to take into consideration.

Once a location has been found, the next issue is to ascertain what is affordable for the company. The ability to obtain the best possible physical facilities in relation to available cash may depend largely on whether the company decides to build, buy or lease the physical infrastructure (Zimmerer and Scarborough, 2005). In the case of a new feedlot, there is no specific location with physical infrastructure to buy or rent. The only option is to build it. This is another reason why the location decision needs to be as accurate as possible for the long-term sustainability of the project.

Location can also be a competitive advantage for a company and in the case of a feedlot location is certainly a competitive advantage, because the better the location in terms of suppliers and proximity to the abattoir *en route* to the market, the more sustainable it will be (Zimmerer and Scarborough, 2005).

The most important elements that must be available on the feedlot site will be discussed subsequently. These elements or factors are specifically chosen due to two reasons: the first being that the feedlot will not be able to operate without it, and the second being the fact that it will be impossible or too expensive to transport these factors to the feedlot site on a continuous basis.

3.1. Infrastructure

Lawrence *et al.* (2007) identify the accessibility of the feedlot for trucks hauling livestock and feeds as the first aspect that must be investigated in any site selection decision when starting a new feedlot. Factors that must be considered are the condition of the road, year-round accessibility and weight restrictions. Other important elements that are advantageous if already available are the electricity supply, some buildings for storage and wind protection (Lawrence *et al.*, 2007).

3.2. Water

According to Clark (2006), "*Cattle must have access to an adequate supply of cool, clean, suitable quality, drinking water.*" During hot (summer) periods animals with a live weight of 450 kg needs approximately 70 litres of water per day. The additional water needed for dust management can be as much as 22.5 litres per animal per day. It must be ensured that these water requirements can be met over an 8 hour period, while at least two days of peak water supply must be stored to ensure against breakdowns in the normal water supply (Clark, 2006).

3.3. Feed

Apart from the cattle, feed is the other bulky item that must be present and, in most of the cases, transported to the feedlot site. The cattle must be fed with a good quality diet consisting of protein, energy, roughage, minerals and vitamins. Although different feedstuffs can be used to formulate a nutritional diet, the main and most bulky ingredients are usually maize and good quality hay. These feeds are bulky and if not produced on the farm the production area must be close enough to the feedlot to reduce the transport cost as much as possible.

3.4. Environmental impact

The environmental impact of a feedlot now receives more attention than in the past. Different environmental impacts, such as the pollution that runoff water might cause to rivers or dams, the increase in phosphorus of the soil and the distance from the closest neighbours that might be adversely affected by the smell, sound and flies must be taken into account. Waste management aught to be carefully planned and the disposure of the manure should meet the necessary environmental guidelines (Clark, 2006; Lawrence *et al.*, 2007). The following part provides more detail of the specific case study.

4. Data and procedures

The specific study area for this research is the former homeland of Transkei. Currently this region forms part of the Eastern Cape Province of South Africa. The region consists of four different municipality boundaries namely: UKhahlamba, Alfred Nzo, O.R. Tambo and Amatole district municipalities. In order to set up a decision matrix, data were used from secondary data sources. These data were used to set up a situational analysis for each region. In order to compare the different locations with each other the SWOT analysis was done by using weights describing the importance of each element and a score to rate each element. This was done to quantify the results from the SWOT analysis. The analysis was divided into two parts, the first to identify the Strengths and Weaknesses and the second to identify the Opportunities and Threats. Every factor in the analysis was judged based on the information obtained from the situational analysis. A score of 0 is allocated if it will contribute nothing to the success of the feedlot, while a score of 10 indicates a significant contribution to the feedlot. This was done for a macro and micro scenario. The criteria on which the analysis was done in the macro scenario are divided into five main headings and a weight was assigned to each. The weights were allocated according to the significance with which each factor influences the success of the enterprise. Table 1 and 2 explain why the exact weight was allocated to each criterion and on what attributes each sub-criterion was judged.

After identifying the most suitable macro area, the strategies of the feedlot must be evaluated in order to find a suitable location. In order to develop the strategies for the business plan a workshop was held with various stakeholders of the feedlot. The methodology used in the workshop to develop the strategies, is based on the balance scorecard theory namely Logical Framework Analysis. From this workshop the objectives and action plans were developed in order to do effective planning of the establishment of the feedlot within a specific area.

The group of participants identified the following concepts:

- Beef production and future potential,
- Maize production and future potential,
- Adequate water resources,
- Availability of trainable labour,
- Availability of inputs (fertilizer, pesticides, herbicides etc.), beef markets

Table 1. Variable explanation of SW analysis

Strengths and Weaknesses		
Criteria	**Weight**	**Explanation**
Water	25%	Water, together with feed, is the most important aspect in deciding where a feedlot should be and have the highest weight. It is needed in large and cannot be transported.
Availability of water		Availability includes current volumes available as well as quality of available water.
Infrastructure	20%	Infrastructure received the second highest score as it will not be possible to erect and successfully operate a feedlot without the necessary support.
Electricity		Availability and type (Two- or Three phase) of available electricity.
Roads		Type and condition of roads to and from the feedlot.
Skilled labour		Availability of schooled labour to be trained in different processes.
Silo		Existing silo's in the area and their capacity.
Abattoir		Existing abattoirs in the area and their capacity.
Inputs	25%	Feed is equally as important as water. The source should also be near the feedlot to save transport cost.
Maize commercial		The current availability of maize from commercial farmers.
Maize communal		The current availability of maize from communal farmers.
Cattle commercial		The current availability of cattle from commercial farmers.
Cattle communal		The current availability of cattle from communal farmers.
Market/Demand	15%	Although the local market is important, the product can be transported to other markets. The market's weight is thus lower.
Population		The current size of the population in the area.
Competitors		The current number and size of competitors in the local market.
LSM Groups		The current wealth of the population in the local market.
Future potential	15%	The future potential is important for the expansion of the enterprise, but it is not a limitation to the immediate implementation thereof.
Maize		The potential of expansion in both communal and commercial maize enterprises.
Cattle		The potential of expansion in both communal and commercial cattle enterprises.

- Infrastructure,
- Business structure,
- Proposed site location.

After obtaining the results, the micro area was evaluated according to the same SWOT methodology as with the macro area. In order to do the SWOT analysis, certain variables were identified – each of these variables received a weight in occurrence with the importance for a feedlot. Table 3 represents these variables along with the explanation of the variables.

Table 2. Variable explanation of OT analysis

Opportunities and Threats		
Criteria	**Weight**	**Explanation**
Water	20%	Due to the fact that a feedlot cannot be build without the availability of water, the opportunities and threats of this resource is a bit less important than in the case with strengths and weaknesses.
Availability of water		Can the water sources and quality be maintained on the same level?
Infrastructure	25%	The improvement or degradation of the infrastructure can hold major challenges for the feedlot and is thus considered as the most important.
Electricity		Possible expansion to the network or shortages in the future.
Roads		Improvement or degradation of current roads and new roads that will increase or reduce the traffic through the area.
Silo		Possible erection or closure of new and existing silos in the area.
Abattoir		Possible erection or closure of new and existing abattoirs in the area.
Mill		The possible erection of a mill of which the by products can be used for the feedlot.
Inputs	20%	The availability of inputs is critical for the establishment of the feedlot. The future situation will affect the feedlot, but it is not as critical as the current situation.
Maize commercial		The possible expansion/reduction of maize production from commercial farmers.
Maize communal		The possible expansion/reduction of maize production from communal farmers.
Cattle commercial		The possible expansion/reduction of cattle production from commercial farmers.
Cattle communal		The possible expansion/reduction of cattle production from communal farmers.
Market/Demand	15%	The future market size may have an influence on the feedlot, but because the product can be transported elsewhere the weight is relative low.
Competitors		Possible increase or reduction of the number and size of competitors in the local market.
LSM Groups		Possible increase or reduction of the wealth of the population in the local market.
Risks	20%	The risks that may influence the feedlot is very important as it must be managed to ensure the sustainability of the enterprise.
Political		Political instability.
Theft		Sources of theft (Lesotho border etc.)
Supply		Shortages in supply due to drought, animal diseases etc.
Regulations		Regulations that may influence the feedlot.
Land claims		Possible land claims on the property of the feedlot.

Table 3. Explanation of variables used in site location

Strengths and Weaknesses	
Existing Infrastructure	What is the status and availability of current infrastructure at the location or nearby?
Roads	Does the current location have accessible roads and is there a possibility of building roads, thus cost is very important?
Buildings (Admin Housing)	Is there buildings in the vicinity of the feedlot that can be used for administration and housing?
Storage	Is there sheds or silo's that can be used for storage purposes, or is there a nearby facility?
Handling pens	Does the location have access to handling pens?
Electricity	Does the location have the necessary electricity available and if not what is the possibility to get electricity?
Available Water	Is there suitable water availability in the region of the location, the location must have at least two sources of water in order to ensure sustainability?
Available Feed	Is there enough feed nearby and is there some space if back rounding of animals are needed?
Skilled Labour	Is there enough skilled labour in the region of the feedlot?
Environmental impact	Will the feedlot have an impact on the current environment? Will nearby residents complain due to factors such as air pollution, noise pollution etc?
Land ownership	Who owns the land and how easy will the potential investors get access to the land?
Opportunities and threats	
Social	What are the opportunities in terms of social impact and will this location ensure a better livelihood for this specific region?
Rural development	What are the opportunities in terms of rural development?
Environmental impact	How big of a threat can this Hub be to the environment in future? Slopes, waste management etc.
Existing infrastructure	How will the Hub help with the establishment of new infrastructure and how will this business assist with the renovation of current infrastructure.
Available water	Does the establishment of a Hub use the water that is used for human consumption? Does the hub form a threat in terms of water exhaustion?
Land ownership	Can an owner claim the ownership of land?

5. Results

5.1. Macro area

In order to examine the 5 possible areas, a situational analysis was done for each town within the specific area. These include the following towns:

- Matatiele/Mount Fletcher (Region 1),
- Tsolo/Qumbu/Mount Frere/Mthatha/Engcobo (Region 2),
- Butterworth/Idutywa (Region 3),
- Comvimvaba/Qumata. (Region 4).

In order to obtain the most suitable area a SWOT analyses was used as described in Table 1 and Table 2. These results are presented in Table 3 with a detailed explanation in the Annexure. According to the SWOT region 1 (Tsolo/Qumbu/Mount Frere/Mthatha/Engcobo) has the highest SWOT rating. Region 2 has a rating of 12.025 which is close to region 1 but the opportunities are less than with Region 1.

This means that Region 1 will be used in the workshop in order to set strategies and to identify the different locations that will be used in the micro SWOT.

Table 4. Summary of macro SWOT results

Item		Region			
		1	2	3	4
	Variables	Matatiele/ Mount Fletcher	Mount Frere, Tsolo, Qumbo, Mthatha, Engcobo	Butterworth, Idutywa	Comvimvaba, Qumata
Strength/ Weakness	Water	5	9	6	9
	Infrastructure	7	7	5	5
	Inputs	8	4	5	6
	Market / Demand	5	5	4	5
	Future potential	8	7	3	6
	Total	6.6	6.45	4.8	6.4
Opportunity/ Threat	Water	6	8	6	9
	Infrastructure	6	7	5	5
	Inputs	7	4	4	6
	Market / Demand	3	5	2	3
	Risk	4	4	4	4
	Total	5.4	5.7	4.35	5.5
	Grand Total	12.025	12.15	9.15	11.9

5.2. Micro area

In this section the different locations identified by the workshop participants will be evaluated by means of using a SWOT analysis.

- **Location 1:** ACAT Farm. This location is next to the R61 in the proximity of the Mthatha dam as well as the Cicira FET College. A Tribal Chief owns this land. According to the farm owner next to the location, the Chief will be open to negotiations, since there are no agricultural activities.
- **Location 2:** Tsolo junction. The second location is a piece of land next to the N2 and the R396 to Tsolo, namely Tsolo junction. The local municipality owns this piece of land.
- **Location 3:** Tsolo College. The third proposed site is at the Tsolo Rural Development Institute, which is situated in Tsolo. The Department of Eastern Cape Rural Development and Agrarian Reform owns this piece of land.

The best location according to the SWOT analysis was Tsolo College – the results of the SWOT are reflected in Table 4. The second best location was the Tsolo junction and in the third place was the ACAT farm.

The Tsolo College (Tsolo Rural Development Institute) has ready access to roads, however, maintenance still needs to be done. In order to get to the site where the feedlot can be built, a river must be crossed. Currently there is a tiny causeway, however, this bridge is damaged and needs some reconstruction. According to the main farm manager at the time, this bridge was due for an upgrade within the next two months. This site has various unused buildings since it used to be an agricultural college and now it only provides training to rural farmers. However, some of these buildings are dilapidated and will need some attention. On the farm there are some silage pits, to produce silage from farm grown maize, as well as old tin silos, however this will need attention and is not big enough for a feedlot, especially not the silos.

The farm also has an up-to-date handling pen and a very small abattoir (for training purposes). The pen was erected at a cost of R1 million and is currently not utilized. The farm already has three-phase electricity at its disposal and Eskom (Bulk electricity provider) is currently erecting a large distribution transformer in Tsolo. According to Eskom this region have enough electricity to serve the Feedlot.

In terms of water the college has a relative large dam that was previously used for fish breeding, and is adjacent to a river. According to the farm manager this river is sustainable and never runs dry, even in winter seasons. Another advantage is that this river is not feeding the previous mentioned dam, which means the river can be seen as an alternative source of water. The farm also has two boreholes, which are used to pump water into a large reservoir on the farm and can serve as a third source of water.

A huge amount of maize is produced in this region, compared to other regions. Various maize producing development projects are also situated nearby. The total farmland size is 1 000 ha with a large unutilised grazing area. This area can be used as a back- rounding (extra land for cattle to

Table 5. Summary of micro SWOT

Variables	Weight	ACAT Farm	Tsolo junction	Tsolo College
		strength/ weakness	strength/ weakness	strength/ weakness
Existing Infrastructure	15%	0.6	0.75	1.05
Roads	/10	5	9	5
Buildings (Admin Housing)	/10	4	1	7
Storage	/10	4	1	6
Handling pens	/10	1	8	8
Electricity	/10	6	5	8
Available Water	25%	1.75	1.25	1.75
Available Feed	20%	1.2	1.2	1.4
Skilled Labour	10%	0.8	0.4	0.5
Environmental impact	20%	0.4	0.8	1.2
Land ownership	10%	0.4	0.6	0.7
Total	100%	25.15	29	40.6
		opportunity/ threat	opportunity/ threat	opportunity/ threat
Social	15%	0.45	0.75	0.9
Rural development	25%	0.75	1.5	2
Environmental impact	20%	0.2	0.6	1.4
Existing infrastructure	15%	0.9	0.9	1.05
Available water	15%	1.05	0.6	0.75
Land ownership	10%	0.4	0.6	0.7
Total	100%	3.75	4.95	6.8
Grand Total		28.90	33.95	47.40

graze on) area if needed or to put animals in isolation. In terms of labour the town is nearby and even though it does not have the skills capacity of Mthatha it is close enough to acquire skilled labour from Mthatha (46km). The feedlot will also have access to the knowledge pool of the college where animal scientists, veterinarians, etc. are employed.

This college is situated a short distance out of town and since it is already a farm, which is not in the direct vicinity of residential areas, the feedlot will have no detrimental effect on the environment in terms of noise and smells. Currently the Department of Eastern Cape Rural Development and Agrarian Reform owns the farm. The department will not object if a feedlot is to be built here and is willing to become a partner in the agribusiness. They are mainly interested because it will benefit the college in terms of training opportunities. However, a contract must be signed between the feedlot owners and the department in order to determine the lease of the land.

The feedlot at the college will have an enormous impact in terms of social development due to the fact that it forms part of job creation in a small town. Since it will be established at the college it can be used to train farmers in feedlot management. This site is already a Rural Development institute and the feedlot will assist in the mission of the institute.

The piece of land is relatively flat and do not have slopes which run into rivers; however, there are suitable slopes for manure management. Thus waste management should not pose any problems.

6. Conclusion

The location of some businesses can be somewhat easier than others, depending on the number of variables and other important aspects that need to be taken into consideration. For a feedlot, it is not that easy because there are macro (including the market) and micro factors that are playing significant roles. It was important to set up a decision matrix from data used from secondary data sources and to modify and adapt it to compare apples with apples for the different macro and micro levels. After identifying the most suitable macro area, some specific new strategies were developed to identify the best micro location for the feedlot. Finding the optimal location through weighted scientific data is definitely the best way for establishing a huge capital investment project like this case study and the whole method, with minor adjustments, can be used in many other location studies.

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II.
NON PEER
REVIEWED PAPERS

MULTI-PERIL CROP INSURANCE AS THE PRIMARY SAFETY NET FOR AMERICAN FARMERS ON THE NORTHERN PLAINS

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NDSU Extension Service

Abstract

The United States Congress has yet to pass new farm program legislation after the expiration of the 2008 Farm Bill last year. Most of the provisions of the 2012 farm program have been extended until September 30, 2013 to cover the 2013 crop. Farm bill legislation is always subject to wide array of proposals promoted by different interest groups and that is occurring this time as well.

Two main ideas have surfaced with rather broad agreement. It is generally accepted that direct payments will not be included in the next farm bill. These payments have been made to producers regardless of production or prices. The other main area of agreement is that federally subsidized multi-peril crop insurance should be protected and become the primary safety net component of the next farm bill.

Crop insurance protects producers very well in the event of individual production losses. However, the potential for crop insurance to provide a long term safety net against loss of price is yet to proven. Producers have experienced the benefit of several years of rising crop prices and therefore, insurance levels. If prices decline for a multi-year period, it remains to be seen if producers can reduce their cost of production enough to deal with the lower safety net in the event of a loss. In addition, crop insurance provides no protection against price losses on the portion of yield above the guaranteed level.

Keywords: U.S. Farm Program, multi-peril crop insurance, safety net, cost of production

Farm policy in the United States has undergone numerous changes since the earliest programs were developed in the 1930’s. The primary goal has been to provide a financial safety net for farm operations in the event of extremely low commodity prices. Loss of yield was typically dealt with by 1) individual producers purchasing insurance against loss of production and 2) legislative action to provide disaster assistance to impacted producers.

Multi-peril crop insurance is overseen by the Federal Crop Insurance Corporation and delivered by private insurance companies. Multi-peril crop insurance is heavily subsidized with the farmer paying, on average, 38% of the premium and the government (taxpayers) paying 62% of the premium as well as providing administrative and operating support to the private insurance providers. The level of premium subsidy varies by type of policy and coverage level.

Prior to the mid 1980’s, multi-peril crop insurance was poorly utilized throughout the country. A higher percentage of acres were covered in the Plains states than other areas of the country. This was likely due to the higher probability of crop loss due to lack of rainfall. Even in these states, less than 50% of the eligible acreage was covered by these policies.

Since the introduction of revenue policies, participation in multi-peril crop insurance has increased significantly. In 2012, 62% of the acreage covered by multi-peril crop insurance and 68% of the policies earning premiums were revenue protection policies. Revenue protection policies provide for a revenue guarantee based on average production history (10-year yield) times coverage level (60 to 85%) times the higher of the spring or harvest time price of the underlying futures market contract. For crops grown on the northern plains, the spring price is the average price of the harvest month futures contract during the month of February. This sets the price for determining the minimum revenue guarantee for revenue protection policies. The guarantee may increase if the harvest month average price is higher than the spring price. Other insurance policies such as yield protection and revenue protection-harvest price exclusion use the same spring price without any upward adjustment if the harvest price increases.

Thus the revenue safety net is very dependent on the commodity price level during the month of February of the current crop year. This has worked very well since 2007. Commodity prices have been steadily rising, providing for a revenue guarantee high enough to cover most if not total cost of production for many producers if they purchased higher levels of coverage. As currently structured, multi-peril crop insurance follows the market, up and down. In addition, there is no linkage to the cost of production. The costs to produce a crop have been steadily increasing for many years. This is reflected by the cost of production index reported annually by the Economic Research Service, shown in Table 1.

Table 1. Prices Paid Index Annual Average 1990-1992 Base, United States 2003-2011

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Index	125	133	141	150	162	188	181	187	209

The Prices Paid Index uses the years 1990-1992 as a base of 100. This index reflects changes in the price of inputs without regard to any adjustments in quantity of inputs used. The index for 2011 is 67% higher than 2003, with the average rate of increase about 8% per year. The only negative change from year to year occurred from 2008 to 2009. This drop in the Prices Paid Index corresponds with the drop in Prices Received by Producers in North Dakota for the three major crops in 2009, shown in Table 2. As crop prices increased substantially in 2010 and again in 2011, the prices paid for inputs increased as well.

Table 2. Prices Received by Producers - North Dakota, 2003-2011, USD per Metric Ton

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
HRSW	131.17	123.46	133.75	164.98	273.74	264.19	180.04	249.12	300.20
Soybeans	243.24	211.28	197.31	219.73	353.84	356.78	340.25	400.51	437.25
Corn	93.30	74.01	70.86	109.05	159.83	147.24	125.19	197.23	228.73

From 2003 through 2005, crop prices were generally flat, yet the Prices Paid Index increased every year by an average of about 7% per year. There is little doubt that the price of inputs is determined partially by what the market will bear. However there is enough inflationary pressure to push input costs up to a small degree even when the ability to pay, as measured by crop prices, declines.

Crop insurance does not take into account cost of production, only revenue. If cost of production and market price do not move up and down together, crop insurance becomes inefficient as a safety net. The prices for major crops and the insurance guarantee have become very volatile in recent years, shown in Table 3. Revenue product crop insurance policies do a reasonably good job of protecting gross revenue within a crop year with a spring (February) and harvest month price discovery. Since the spring price sets the minimum guarantee for revenue policies for that crop year, any lost production below the guarantee level is indemnified at the higher of the spring or harvest time price. But this guarantee is only for lost production below the guarantee level. If the market price declines during the year, any yield actually produced is potentially worth less than the guarantee. In addition, yield above the guarantee level is subject to loss in value if market prices decline during the season. This portion of the expected yield is not covered by the insurance policy. Revenue insurance policies alleviate some of the risk in forward pricing a portion of the crop before actual yield is known. The risk of pricing the crop before the yield is known lies in the market rising above the contracted price leaving the producer with having to make up the difference between the contract price and the price level at the contract delivery time period, if a shortfall in production occurs.

From year to year, there is no consistency in price levels and therefore in the level of coverage a producer is able to purchase. Each year, crop insurance prices are reset during the spring discovery

Table 3. Crop Insurance Safety Net Analysis for East Central North Dakota using Projected Yields, Costs and the Projected (Spring) Crop Revenue Insurance Price

Spring wheat	2008	2009	2010	2011	2012	2013	2014
Yield	2.49	2.62	2.76	2.96	2.96	2.96	2.96
Crop Insurance Price	408.11	227.75	199.46	363.29	287.99	310.03	238.77
Revenue Guarantee	711.03	418.24	385.08	752.70	596.68	642.34	494.69
Direct Costs	306.06	365.78	315.82	408.53	454.10	467.81	467.81
Overhead Costs	161.13	179.79	191.77	198.47	220.64	249.15	249.15
Total Listed Costs	467.19	545.57	507.59	607.00	674.73	716.96	716.96
+Labor & Mgmt	77.88	79.83	81.83	83.87	85.97	88.12	88.12
Total All Costs	545.07	625.40	589.42	690.87	760.70	805.08	805.08
Guar%/Total Costs	130.4%	66.9%	65.3%	108.9%	78.4%	79.8%	61.4%
SOYBEAN							
Yield	2.02	2.09	2.02	2.02	2.02	2.02	2.02
Crop Insurance Price	490.76	323.25	339.05	495.53	461.00	472.76	404.07
Revenue Guarantee	693.26	471.86	478.95	700.01	651.23	667.84	570.80
Direct Costs	244.46	315.18	305.17	332.28	360.64	389.50	389.50
Overhead Costs	164.02	180.65	191.06	197.58	219.72	249.20	249.20
Total Listed Costs	408.48	495.83	496.23	529.86	580.36	638.70	638.70
+Labor & Mgmt	77.88	79.83	81.83	83.87	85.97	88.12	88.12
Total All Costs	486.36	575.66	578.05	613.73	666.33	726.82	726.82
Guar%/Total Costs	142.5%	82.0%	82.9%	114.1%	97.7%	91.9%	78.5%
CORN							
Yield	6.32	6.79	6.86	7.00	7.27	7.60	7.60
Crop Insurance Price	198.36	148.40	146.57	220.77	208.65	207.54	174.48
Revenue Guarantee	878.00	705.79	703.95	1081.13	1061.07	1104.33	928.42
Direct Costs	503.15	650.59	569.49	665.49	754.05	819.46	819.46
Overhead Costs	195.04	221.38	232.82	240.03	264.50	302.72	302.72
Total Listed Costs	698.18	871.97	802.31	905.52	1018.55	1122.18	1122.18
+Labor & Mgmt	103.84	106.44	109.10	111.83	114.62	117.49	117.49
Total All Costs	802.02	978.41	911.41	1017.35	1133.17	1239.67	1239.67
Guar%/Total Costs	109.5%	72.1%	77.2%	106.3%	93.6%	89.1%	74.9%

* Note: Yields are in metric tons per hectare and monetary units are US dollars per hectare

period. Spring insurance prices are determined by the markets expectation of the harvest-time price for the new crop. Major changes in supply and demand can result in significantly different price levels from one crop year to the next.

If projected prices are very high during the month of February, it may be possible for producers to insure at a level that guarantees a profit. Likewise, if prices are very depressed during the month of February and remain low through the harvest month contract, the safety net provided by crop insurance may be low enough to result in severe financial hardship in the event of a significant loss.

Currently, there is significant support in the agricultural industry to rely on crop insurance as the primary safety net in the next farm program. The insured price of major commodities has been very attractive and generally rising since 2006, shown in Table 4. This extended period of excellent coverage may be leading to some denial of the outcome should prices begin a multi-year downward trend. The declining coverage as a result of lower insurance prices would be further compounded by the cost of production which may not be as quick to adjust to the lower price levels.

Table 4. Revenue Protection Insurance Prices, 2003-2011, USD per Metric Ton

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
HRSW	138.52	146.97	127.13	204.66	242.88	408.22	227.81	260.15	363.39
Soybeans	268.96	246.92	211.28	227.08	358.25	490.90	354.94	427.33	495.67
Corn	93.30	111.41	91.33	140.15	159.83	212.59	159.05	217.31	248.81

Costs of production indices for some of the major inputs needed for crop production are shown in table 5. Over the past 9 years, the price of all of these inputs has increased, but there has been considerable variation in the level of increase. It can also be argued that the ability to impact the cost of these items by individual producers varies considerably by input item. The cost of inputs to the farm business can be altered by 1) the quantity used and 2) the price per unit. To deal with potential declining commodity prices and therefore, declining value of the crop insurance safety net, producers will have to make adjustments to the overall cost of inputs to the extent they have any control.

Table 5. Cost of Production Index, Selected Items, United States, 2003-2011

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Seeds	154	158	168	182	204	259	299	310	332
Fertilizer	124	140	164	176	216	392	275	252	328
Chemicals	121	121	123	128	129	139	150	144	145
Fuels	140	165	216	239	264	344	228	284	362
Machinery	151	162	173	182	191	209	222	230	244
Rent	123	126	129	141	147	165	184	190	205
Interest	94	126	129	133	142	147	138	132	135
Wages	157	160	165	171	177	183	187	189	192

Reducing the quantity used for most of the inputs listed would have a significant potential to reduce production as well and thereby be counter-productive. The most likely exceptions would be machinery and interest inputs. By reducing or delaying machinery purchases, the total machine cost per unit of production may be held in check. This will also reduce the need for financing, therefore reducing the interest expense. If there is excess hired labor on the farm it may be possible to reduce this input but most operations do not have excess labor capacity.

The ability of individual producers to impact the price of inputs used is insignificant for most of the listed items with the exception of rent. Land rent is the one input producers have more ability to set the level. It is also one of the largest input items for most major crops. Many land rent contracts are multi-year and therefore may be slow to adjust. But an extended period of low profitability will eventually lead to some level of decrease in land rents. It is difficult to see where individual producers can have much impact on the price of any of the other listed inputs. Any reduction in price level is likely to come about as a result of the industries involved finding it necessary to reduce prices to remain competitive in a financially weaker market.

Conclusions

Federally subsidized multi-peril crop insurance is currently being pursued as the primary component of the safety net in the next U.S. farm program. This is being touted as a more market oriented alternative to direct payments. Direct payments have been made regardless of the need and have come under considerable scrutiny during recent years of record net income levels for the crop production sector in the United States.

Crop insurance works very well as yield insurance. The level of coverage is at the individual insurance unit level and accounts very well for individual losses. Yields used for insurance levels do not change significantly from year to year and are generally reflective of trend yields due to improvements in technology. Therefore the coverage level due to yield is very stable and predictable from year to year.

The effectiveness of the price component of revenue protection insurance policies is less clear. Since 2007, the price level determined for revenue policies has been quite favorable. This has resulted in strong support for protecting crop insurance as the primary safety net component of the next farm bill. It remains to be seen if the reliance on crop insurance is acceptable if crop prices and therefore insurance price levels decline for an extended period of time. Crop insurance does a good job of protecting against individual yield loss. How well crop insurance effectively protects against systemic losses such as price declines is less clear.

Individual producers can alter their cost of production to some degree but not likely enough to offset a significant downturn in crop prices. A multi-year period of crop prices below cost of production will likely result in pressure from farm groups for another disaster compensation program.

INTERGENERATIONAL FARM TRANSFER RESEARCH: POLICY IMPLICATIONS

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Abstract

Public policy favoring the organization of agriculture through the farm family business has been a long held foundation of agricultural policy in the industrialize democracies. Much of this policy has been based upon an ideal typology that focuses upon the relationships of the farm and the family to the land and the processes that shape those relationships. An ideal typology that focuses on relationships provides little quantitative data and while such typology may be appropriate in developing it may not be appropriate to the implementation of such policy. The implementation of policy often requires some quantifiable data that will determine the inclusion or exclusion of farms for policy benefits. Given that policy favors family farms a key to their sustainability is the ability to transfer the farm land and the farm business to a successor generation. The complexity of the process of intergenerational transfer is little understood and under researched. This lack of research and the information that could be derived for it has affects the formulation of public policy.

The FARMTRANSFERS international farm succession research project has over 15,500 replications of a postal questionnaire. Accepting the limitation of time, location and culture it has produced a valuable and unique set of data that upon analysis yields insights into differences in farm policy based upon legal system and culture. A summary of selected policies is offered in by the authors of this paper. The paper concludes with observations on the future of the farm family business and the attributes of the successor of the future.

Keywords: family farm, successor, typology, research, public policy

1. Introduction

Many of the conclusions reached in this paper are predicated upon the *FARMTRANSFERS* international research project. *FARMTRANSFERS* employs a copyrighted questionnaire developed by Professor Andrew Errington. Data is collected through a postal questionnaire designed to capture a range of information on plans for succession and retirement, information sources used, expected retirement income sources and detailed information on the delegation of decision-making responsibility between the principal farmer and his/her successor(s), as well as basic background information on the farm. The survey has now been replicated in ten countries and in seven States in the United States (see Table 1) and the questionnaire has been completed by over 15,600 farmers.

By adapting a common questionnaire to investigate patterns of farm succession, retirement and inheritance in a diverse range of social, cultural and economic contexts, *FARMTRANSFERS* has developed a unique database of comparable information. The limitations of this approach have both strengths and weaknesses. Obviously there are limitations imposed by a standardized postal questionnaire format, a wide range of social, cultural and economic differences in the countries, states and provinces surveyed means it is necessary to adapt each replication slightly. Individual replications of the survey can also vary considerably in terms of the year of the survey and sample size. Having acknowledged such limitations, the *FARMTRANSFERS* survey has produced a range of (largely quantitative) data relating to the pattern, process and speed of succession and retirement and allows for an international comparison of the results which is not possible using other data sets. Admittedly the *FARMTRANSFERS* research methodology may not be methodically perfect but it does help to illuminate a complex, fascinating and important aspect of family business life.

Table 1. FARMTRANSFERS replications

Australia (2004)	North Carolina (2005)
Austria (2003)	Pennsylvania & New Jersey (2005)
California (Humboldt County, 2004)	Poland (2003)
Canada (Ontario & Quebec, 1997)	Romania (2009)
England (1991, 1997)	Switzerland (2003)
France (1993)	Tennessee (2010)
Germany (2003)	Virginia (2001)
Iowa (2000, 2006)	Wisconsin (2006)
Japan (2001)	

The family farm has continues to hold an important place in the production of food and agricultural commodities, in the formulation of policy and in the societies of countries. During the formative years of the Common Agricultural Policy, family farming was considered to be an important part of the European rural society and rural economy. The founders of the European Community recognised the importance of the "social structure of agriculture based on the family farm" (Fennell, 1987 p.5). In the early years of the EEC family agriculture was consider the 'economic engine' driving rural development and its economic position was coupled with an important social role.

Ideas about the family farm have also played an important role in the persistence of the North American agrarian ideal. Founding father of the United States, Thomas Jefferson argued that farmers were the most valuable citizens and "the most independent, the most virtuous, and they are tied to their country and wedded to its liberty and interests by the most lasting bonds (Jefferson 1785, quoted in Browne et al 1992). Writers in the 19th century added a new dimension by stressing the moral and spiritual benefits of farm work. Thus the 'myth' of the family farm combined "Jefferson's hardworking yeoman with a legendary superiority stemming from the prevailing Protestant work ethic of handwork as a measure of moral worth.

This raises the question of what is the definition of a "family farm". Two approaches are commonly employed. The first is the ideal type that is widely used in research and typically highlights relationships, e.g. the relationship between the farm business and the family and the resultant consequence of such relationship. Such approach mainly examines the differences in processes among different groups and the propensity to behave in a certain way.

Long-time observers of family farming Ruth Gasson and Andrew Errington developed an ideal type definition based on the following multiple criteria:

1. Business ownership is combined with managerial control in the hands of business principals,
2. These principals are related by kinship or marriage,
3. Family members provide capital to the business,
4. Family members, including business principals, do farm work,
5. Business ownership and managerial control are transferred between the generations with the passage of time,
6. The family lives on the farm (Gasson and Errington 1993 p.18).

An alternative definition of a family farm employs and operational definition and is commonly see employed to determine eligibility for available government or private programs that support farm businesses. The operational definition of a family farm employed by the United States Department of Agriculture's Economic Research Service defines a family farm as "any farm where the majority of the business is owned by the operator and individuals related to the operator by blood or marriage, including relatives who do not reside in the operator's household" (Hoppe and Banker 2010 p.2) and therefore 98% of farms in the US fit within this definition.

Perhaps more useful is the USDA/ERS farm typology which not only distinguishes between small and large family farms but identifies a range of other farm types and subdivisions, including retirement farms and residential/lifestyle farms.

Table 2. USDA Economic Research Service Farm Typology

<table>
<tr><td>Small family farms
(gross sales less than $250,000)</td><td>Large-scale family farms
(gross sales of $250,000 or more)</td></tr>
<tr><td rowspan="3">Rural-residence family farms:
Retirement farms. Small farms whose operators report they are retired.
Residential/lifestyle farms. Small farms whose operators report a major occupation other than farming.
Intermediate family farms:
Farming-occupation farms. Small family farms whose operators report farming as their major occupation.
• Low-sales farms. Gross sales less than $100,000.
• High-sales farms. Gross sales between $100,000 and $249,999.</td><td>Commercial family farms:
Large family farms. Gross sales between $250,000 and $499,999.
Very large family farms. Gross sales of $500,000 or more</td></tr>
<tr><td>Nonfamily farms</td></tr>
<tr><td>Any farm not classified as a family farm, that is, any farm for which the majority of the farm business is not owned by individuals related by blood, marriage, or adoption.</td></tr>
</table>

The economic, social and environmental setting for the farm family business has changed dramatically in the last three decades, profoundly affected farming and family farming. The changes during this period include:

- continued decline in farming incomes in real terms,
- decline in the influence of farming and the public perception of farmers,
- greater focus on the relationship between farming practice and the environment ('agriculture as the engine of destruction'),
- policy movement towards rural development, to encourage the diversification of resource use and the stimulation of employment opportunity,
- further developments in technology, easing the need for labour on the land and enabling longer working lives (assisted, perhaps, by improvements in health).

An obvious first place to start is the identification and presence of a successor, which is dependent on a number of factors, key among them, is the presence of children or close relative in the family and their desire be the successor. The presence of a successor, alone, has been noted as having an impact on the decision making in the business (*the succession effect*), with a close clear correlation between this and the propensity for the principal to have plans for semi- retirement (Potter and Lobley, 1996; Lobley, Baker and Whitehead, 2010). Tradition, Custom and Policy supporting family farm succession.

In order to encourage the intergenerational transfer of the farm family businesses a number of different approaches have been employed by governments and other organizations. Such approaches included financial assistance to encourage the transfer and help with restructuring of the farm business, approaches through fiscal policy to help with capital exchanges from owner to successor, innovative land tenure arrangements may be very important, educational programs to effect informed decisions before and during the succession process and matching services that match landowners/farmers with qualified new entrants.

2. Financial support for farming

Financial support for farming has been implemented by and has been a continuous feature of the policies of most governments in the developed world. Such support was based on the idea the increased financial viability of family owned farms would result in their continued existence. Financial support for new entrants has been a significant part of such policies. In the US the USDA Farm Service Agency provides beginning farmer loans at reduced interest rates. Several state have beginning farmer loans that are bond guaranteed thus reducing the risk to the lender and resulting in a lower interest rate for the borrower.

In the EU the focus of support has shifted to providing incentive for environmental management and rural development. In recognition of the continuing importance of farm businesses in the EU was the introduction in 2003 of the single payment to farmers.

3. Retirement

With few notable exceptions in most countries the majority of farmer indicate they with either never retire or will semi-retire and a significant minority report the will fully retire. If the principal operator never retires the opportunity for an intergenerational transfer is significantly reduced due to either the failure to transfer managerial decision making in a timely manner or the inability of the farm to provide the income for the owner and the successor.

Those farmers who responded to the *FARMTRANSFER* that they would fully retire were asked about their sources of income in retirement. A significant source of retirement income will come from the operating income of the farm. A second significant source of retirement income is derived either from sale or lease of the assets farm business assets.

A number of *FARMTRANSFER* researchers have reported provisions for inheritance and the receipt of state pension, encouraging succession. An interesting variance on the question of farm inheritance is evident in Switzerland where, direct payments are receivable until 65 (full handover). Also in an endeavour to promote family farm succession, the value of the holding on conveyance from principal to successor is prescribed by law as the capitalized earning capacity of the holding. Further pressure can come at this time, as the state pension scheme exempts farmers from the requirement to subscribe to an additional occupational pension plan which may not cover the cost of living. In many case therefore the principal is dependent on income and housing from the farm, not a conducive situation for maximum succession effect!

Perhaps more of an encouragement, in Japan, the Farmer's Pension Scheme, has provided additional Government contributions to the scheme for young farmers, payable on transfer of the farm business to successors at 65 years of age.

4. Inheritance custom and law

The complexity of custom and legal requirements for a decedent's property varies greatly from country to country. In some cultures the custom has been for inheritance of the whole by one beneficiary, male or female only, or either. In other cases, a more egalitarian approach is the custom, with the share of the estate equally between children. Primogeniture, the passing on of the estate of the deceased to the first born in the family, is predominantly an Anglo-Saxon approach to succession.

The greatest strength arising from the tradition of inheritance of the whole by one beneficiary is the preservation of the holding as a unity. A degree of decline in this practice is, however when the selected successor has pursued other career opportunities or the parents are concerned that the occupation of farming has little economic future. In other cases, children who are the most interested in farming are given a larger share of the farm assets or the parents are driven by a sense of fairness to divide he farm equally among their children. The farm may then be leased by other members to the family member who is most interested in the continuation of the business on the land. The problem arises that one generation or more have built up the holding or developed first class breeding lines in livestock, for example for which little or no accounting is made. The rapid rise in land values cannot be ignored and has led in many cases for the land to be sold and the proceeds to be divided among the heirs.

A range of fiscal provisions are possible to assist with succession. In the UK, taxation on the transfer of the estate of the deceased has long been seen as the major factor on the breakup of the large landed estates of the nineteenth century. In recent times, this has been replaced with an Inheritance Tax. Here, providing the estate is transferred to the beneficiary(ies) and the benefactor survives this transfer by seven years or more, the tax is totally avoidable. Although not strictly targeted at farming or succession, the benefit to succession is clear – the estate of the farming principal avoid break up in order to pay tax.

In the US the States and the Federal government have a variety of taxes that may be levied upon the transfer of farmland through the estate of a decedent. However there are liberal exemptions, tax credits and valuation techniques that may be employed to lessen or eliminate such taxes. Federal Estate tax allows for the transfer of $5.24 million per individual and $10.5 million for a married couple without any tax. Farmland may also be valued at its productive capacity rather than is speculative market value thus allowing more land to be transferred to a beneficiary without any tax. In some state, Iowa for example, there is no tax on transfers of farmland to a lineal descendant or ascendant.

Perhaps considered as one step further than this, in Japan, in an endeavour to keep small holdings from becoming smaller, the Government exempts farmland transfer from inheritance tax where the transfer is to one successor alone.

5. Land tenure arrangements

The flexibility of land tenure arrangements (relating to agricultural and non-agricultural property) can be a major contribution to the succession process, in providing a means of keeping the occupation of the land as a whole, for example, where the freehold for the property has been transferred in equal shares. In addition, flexible legal provision may also offer the opportunity for growth of the business, or its diversification, allowing the business to support more than one family through the succession stages. By way of example, such flexibility was provided in England and Wales in 1995, with root and branch review of the agricultural tenure system in these countries. This moved the nature of the agricultural tenancy from a prescriptive tenant-orientated provision to a more flexible tenancy, in the hope of freeing up more land to provide greater opportunity for new entrants. In effect, the new tenancies have provided opportunities, not for new entrants to farming (i.e. starters), but for existing farmers (and their successors) to enlarge their businesses as mixed tenure holdings, with clearer facility to incorporate diversified enterprises on tenanted land (Whitehead et al, 2002).

The rapid increase in the value of farmland in the US has outpaced the ability of the various Federal and State programs to finance the purchase of farmland. Increasingly new entrants, including successors to existing farms, are employing novel long term lease arrangements to posses and control the use of the land without the need to own it. While this is still relatively new there is a growing recognition that farmer and landowner need not be synonymous terms.

6. Matching services and succession education programs

The 2008 Farm Bill (Food, Conservation, and Energy Act of 2008) established the Beginning Farmer/Rancher Development Program. The goal of the program is to enhance the food security of the United States by providing beginning farmers and ranchers and their families with the necessary knowledge and skills to make decisions concerning the future sustainable farming of their properties. The USDA provides grants to successful applicants to develop programs that will enhance entry into farming.

There is a great deal of continued support for family farming, in some cases, providing specific encouragement in terms of the succession process. These approaches have, however, been criticized for not targeting only those transfers of the farm and the business would not have occurred in the absence of such support. Having noted that criticism, and given the complex process of intergenerational transfer continued intervention, perhaps in more economically challenging times, will need to be very carefully considered and targeted to achieve maximum effect in any particular circumstance.

7. Imperatives for the future

What is clear is that despite the resilience of the farm family business and the desire for continuation of family owned farm targeted support, both financial and non-financial, may be needed in order to ease challenges, present and future. The presence of an enthusiastic and qualified successor to take over the business is critical to the sustainability to the family farming system. Policy development will vary according to circumstance and should not be based on a ‘one for all’ model. Family farms are heterogeneous in nature and in the means by which to respond to future challenges. As the typology suggests, the need for, the level of and the appropriate approaches towards support in the future will vary. For the lifestyle/residential family farm, for example, this may entail targeted support to secure specific habitats, landscape and social / community structures recognised as of local, national of international import. In contrast, for the agribusiness family farm assistance is more likely to take the shape of that which facilitates further restructuring, such as improvements to tenure arrangement, to assist with the establishment of the mixture bundle of rights, along with appreciation of the need for growth from the planning system.

Continuity of management, through close relationships between family members, the ‘sharing’ of capital assets and the detailed knowledge of the farm resource all contribute to the strength of family farms. The successors of the future will have to be highly motivated, skilled in technical and business matters and capable of accepting change and planning appropriate responses. Without this, the risk is that the cornerstone of agricultural business in across the developed world will fail to meet local, national and global expectations.

FARM MANAGEMENT PLANS

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Abstract

Farmers have been encouraged, for many years, to apply a more formal and rigorous planning approach to their business management functions. The preferred documents accompanying the planning are strategic plans or business plans. Setting a strategy refers to developing a plan that documents where a farmer sees his or her business in the future and what management and investment decisions have to be made to attain the vision. Business plans are more focused on a specific concept or project, usually within a defined timeline. The two planning functions can exist on a standalone basis but more typically, one would expect a business plan to harmoniously be working toward achieving the longer term strategy. Strategic plans will generally have a five year horizon with a three to five year focus for business plans. Plans that have a one year timeline are usually more operational in nature. Having an operational plan would be a minimum expectation.

But the reality is that the majority of farms have no formal plans at all. Farmers will have operational plans but they reside in their heads. The absence of any formal planning hierarchy does not, in itself, result in failure. In fact, many farms have been very successful with no written plans at all. This paper will not argue the relative merits of strategic, business or operational plans. It will present an alternate approach to planning.

Keywords: farm, management, planning, strategy, finance, operations

1. Introduction

Farmers have been encouraged, for many years, to apply a more formal and rigorous planning approach to their business management functions. The preferred documents accompanying the planning are strategic plans or business plans. Setting a strategy refers to developing a plan that documents where a farmer sees his or her business in the future and what management and investment decisions have to be made to attain the vision. Business plans are more focused on a specific concept or project, usually within a defined timeline. The two planning functions can exist on a standalone basis but more typically, one would expect a business plan to harmoniously be working toward achieving the longer term strategy. Strategic plans will generally have a five year horizon with a three to five year focus for business plans. Plans that have a one year timeline are usually more operational in nature. Having an operational plan would be a minimum expectation.

The reality is that the majority of farms have no formal plans at all. Farmers will have operational plans but they reside in their heads. The absence of any formal planning hierarchy does not, in itself, result in failure. In fact, many farms have been very successful with no written plans at all.

This paper will not argue the relative merits of strategic, business or operational plans. It will present an alternate approach to planning. It is possible for farmers to successfully manage their businesses by focusing on marketing and operations. However, as farms continue to advance through their business and family lifecycles, they need to re-focus their attention. Many will intuitively know that they need to make some changes in their business management functions. The challenge is three-fold; knowing what options exist, determining which option best meets their needs and, knowing how to go about implementing the change(s).

2. Commitment to management change

2.1. Bill Gates is credited with the following:

This is a fantastic time to be entering (or be in) the business world, because business is going to change more in the next 10 years than the last 50.

We always overestimate the change that will occur in the next 2 years and underestimate the change that will occur in the next 10. Don't let yourself be lulled into inaction.

They have direct application to primary agriculture. Everyone knows that change in farming is hardly anything new. There is a business axiom that states that a business – including farms – will typically outgrow its management. Growth in the literal sense of more acres or animals. Growth also in complexity in terms of how many people are involved in ownership and management, generational transition, and the diversity of the business enterprise mix. Managerial development, and change, is required. Even if a farm has been relatively stable, the requirement to advance business management applies to maintain the status quo. Failing to do so runs the risk of slippage, in relative terms, as compared to other farms in similar situations.

The reality is that there are some things that, from a farm management perspective, are really challenging for farmers to do. Farmers will have identified the need to make changes in how their farms are being managed. They will have come up with ideas on what the changes might look like. They will often express their frustration in the difficulty in their implementation.

There are a few reasons why this happens. One is procrastination. There generally is no any real urgency – as in 'this needs to be done this week' - to the adjustments. But, pretty soon a month or two slips by with no action and soon a new production season is looming. This is the second reason. The production season for farmers is critical, justifiably filled with urgency and stress. In these situations, human nature causes people to revert to what has worked in the past. When the production season ends, it is back to the drawing board when it comes to making adjustments to those management plans.

There needs to be a plan. The third reason. The lack of a plan is a significant stumbling block to change. How simple or complex the plan is becomes a factor. The third reason is related to the ownership and management structure of the farm business. Management and ownership are almost always one and the same. So, if the person who is responsible for making the changes in management is not getting the job done, who do they report to? Themselves? The lack of accountability can be a major issue and at the same time, one of the easiest to remedy. Change is unavoidable. How farmers deal with it is what is important. Lao Tzu stated that *If you do not change direction, you may end up where you are heading.*

An alternative to the more traditional approaches to planning is the development and implementation of a management plan or program.

2.2. Management plans

Management plans are somewhat of a hybrid when it comes to planning. They differ from strategic or business plans in that their focus is on implementation – answering the 'how' questions. In that respect, they more closely resemble operational plans. But they differ from operational plans because they more actively consider longer term strategy and mandate continuity in their implementation. The connection between a management plan and strategic plan can be expressed as “if this is what we’re doing (the ‘how’), is it getting us to where we need to be (the ‘where’)?”.

Strategic, business or operational plans can be somewhat abstract exercises – plans often designed to meet the requirements of a third party or simply because the expectation is that a farm has a formalized plan. There usually are gaps between the plans their implementation. Farmers who work within the framework of a management plan value the practical application of the planning activities associated with developing and implementing their plan or program.

2.3. Three key alignments

There are alignments that should be kept in mind when managing farm businesses. The alignments referred to being strategic direction, financial performance and management structure. This is nothing new as these functions have impacted on farms for decades. What is new is the importance of more proactively understanding them and monitoring their alignment as a farm business moves through its lifecycle.

2.4. Strategic direction

This alignment consideration is really about strategic direction. Farms and farm families should have written vision statements that define longer term direction of the farm and family. A vision is the foundation of the future: what they want their farm business to become.

Practically, it should describe where they see their farm business five years from now. It is not set in stone. The vision will evolve over time and as situations change. It represents the direction of the business or where the business is headed

2.5. Financial performance

All farms have an existing financial direction. The reality is that they are headed somewhere financially. For most farmers, this is a reactive function meaning that the financial position in the future - say five years from now – will be an outcome of what will happen over that time frame. The preferred approach is to define what is wanted, or required, in a future financial position. And then determine what can and needs to be done to achieve it. It can be thought of as creating a financial vision. It should include financial targets and investment guidelines. There is a business adage that says that you can’t manage what you can’t measure. How does a farm family know if they are tracking to where they want to, or need to, be financially if they have not defined the goal?

Logically, there should be a significant degree of alignment between a business vision and a financial vision. Sometimes there is a disconnect between the ideas of where a family wants their farm to be in the future and in their ability to get there financially. Having a dream and then after a time, realizing it cannot be afforded can be discouraging. Like setting out on a trip and part way along the journey, realizing that there is not enough gas.

2.6. Management structure

The importance of understanding a farm’s management structure, as farms increase in size, and complexity has never been greater. The basic management functions on a farm are the same but what’s involved in attending to those functions has changed and is changing. For many farms, this is a new and evolving reality.

Simply stated, what does the management structure of a particular farm need to look like in the future so that it is appropriately aligned with its business vision and preferred financial future? Putting some structure around the management functions on a farm can be a very powerful exercise, but not necessarily a complex exercise.

Three key alignments include: creating a business vision, putting definition around a desired financial future and, developing a management structure that reflects the current reality and future requirements. Once developed, it is possible to monitor their alignment and make adjustments that will be required to keep them aligned.

2.7. Structured approach to management plans

The process as outlined in this paper uses a structured approach to developing and implementing a management plan. The components of the planning process are identified in detail and in chronologic sequence. There are milestone components, or components that must be completed before moving on to the next planning activity. There is variability in the amount of time required to work through each planning component.

There is clarity and agreement on what needs to happen, in what order and against the agreed upon timeline. The planning process includes work that the family has to do on their own time. If there is a desire to work through the planning process as expeditiously as possible, the family has to commit to making the effort to 'get their homework done'. If the family realizes that the commitment required to meet the timelines cannot be met, then adjustment to the timelines can be made.

The actual planning process can be organized into three phases. Preparedness Assessment. Framework Development. Management Plan Implementation.

2.8. Preparedness assessment

Farm businesses and families will be different places in their lifecycles. They may identify a desire and willingness to work through a process that develops and applies a more structured approach to their management functions. However, not all will be prepared to work through it. As farms have grown in size and complexity, the process has become more involved. It is generally accepted that these trends will continue which makes it increasingly important that farms work through a preparedness assessment prior to investing the time, money and resources in developing a management plan. There are farms that are simply not ready to apply a more structured approach to their management practices. It is far better to come to this realization early on and easier for ownership and management to make the necessary adjustments before beginning to work through the process.

The Preparedness Assessment includes quantified and qualified assessment. The steps include:

- Setting goals:
  - Looking for convergent and divergent goals.
- Values:
  - Determining how core values are aligned.
- Financial Performance
  - Determining the farm's historic financial capacity.
- Management:
  - Reviewing management practices to determine relative strengths and weaknesses.
- Historical Business Development:
  - Documenting key, historical business development and correlated management rationale.

The Preparedness Assessment Phase concludes with a ‘communication meeting’, or a meeting with all family members who are part of the planning process to review their ‘preparedness’. If the farm is generally prepared, then the planning can continue. If not, then ownership and management can take the necessary steps to get prepared before proceeding.

3. Framework development

The management plan is a good as the process that is followed and the detail of activity included within the process. The process as outlined below is quite structured. There is a risk that farm families get bogged down in the planning, resulting in situations where they circumvent steps or, worse, discontinue altogether. The Framework Development Phase is best served when it is championed by an external facilitator. The facilitator must manage participant commitment and involvement against expectations, timelines and desired outcomes; keeping the process moving, knowing just how much time to spend on each step and knowing when to circle back to issues that need to be discussed and re-clarified.

3.1. Strategic direction

- Guiding Principles:
  - Within the three broad categories (major concerns, planning objectives and strategic objectives) are points that are important to consider when developing a management plan.
- Vision:
  - Defining what the future is for the farm and family is very important. It helps to put some definition to what people want and what to plan toward. This is vision.
- Situational Analysis:
  - Farms operate within internal and external surroundings. They can be defined by examining strengths, weaknesses, opportunities and threats (SWOT). Understanding the situation forms a base from which to proceed.
- Risk Assessment:
  - Farm families deal with risk all the time. But, there can be risks that have specific importance from long term management perspective. The assessment helps to identify the risks, from which mitigating actions can be taken.
- Critical Issues:
  - What are the things that farm families need to get right to make sure that they have the best chance at being successful? These critical issues are found in different areas of management and need to be identified and actions taken to address them.
- Action Plans:
  - Once the critical management issues have been identified, detailed action plans should be developed. Action plans bring accountability to the planning process and implementation, and keep it moving forward.
- Communication:
  - Regular and structured communication is critical to the planning process, its implementation and to achieving desired outcomes.

3.2. Financial performance

- Financial Targets:
  - Implementing a management plan will affect the farm's financial performance. Setting targets for key ratios puts upper and lower limits on the performance.
- Forecasting Financial Performance:
  - The past five years income statements are averaged. The average is applied to the most recent balance sheet and used to forecast the financial position five years into the future.
- Financial Performance – Scenarios:
  - Using the farm's past and forecasted financial performance as a baseline, and using the financial targets that are set, families can measure the impact that different business scenarios will have on the farm and family's financial performance. This information is used to help make the best decisions possible.

3.3. Management structure

- Governance:
  - Planning must include discussion on governance or how the farm will be organized and managed. Governance discussion should include organizational charts in their present and future form (3 and 5 years hence). This is very helpful when determining professional development plans for key family members and farm employees.
- Human Resources:
  - Attention to the farm's human resources is a critically important element in planning. Consideration should be given to employees, their roles and performance. As or even more importantly, consideration must be given to the farmer(s)' own human resource – how they manage their time. Ownership roles, responsibilities and accountabilities within the planning process should be defined.
  - Training and related professional development must be aligned with human resource management.
- Communication:
  - The finalized plan is ready to be shared, as per the direction of the family, with stakeholders, both internally and externally.

3.4. Management plan implementation

Without implementation, there is no return on the investment in developing a management plan. Problems with implementation are associated with the challenges associated with change, as noted in this paper. Building accountability into the management plan helps with implementation. Accountability can be internal, external, or preferably, a combination of both.

Having regular meetings and engaging a management advisor are the most effective ways of making sure a plan is implemented. An annual minimum is two meetings. One in the fall, typically at the end of the production season. The other in the winter. The fall meeting follows an annual general meeting format with reports to owners and stakeholders. Strategic direction is reviewed with enhancements made as required and as situations and circumstances change. The winter meeting focuses on financial performance and management structure. Past year financial performance is tested against targets and forecasted baseline performance. Management structure is reviewed in the context of the financial performance. Less than desired performance is analyzed with changes in management structure incorporated into the plans for the coming year.

The ongoing process of reviewing performance and testing against goals and targets keeps the management plan current and therefore, relevant. It provides context for decisions that need to be made to best ensure that the strategic direction is maintained.

Another longer term, and associated, outcome could be the farm's ability to utilize an external management resource – a farm advisory board. Accountability to an advisory board can also assist with implementation.

4. Conclusions

One of the most important outcomes to developing and implementing a management plan is ensuring longer term and sustained business, personal and family success. The importance of applying a more formal and rigorous planning approach to managing farms in the current, global environment should not be understated. The reality is that the majority of farms have no formal plans at all. The absence of any formal planning hierarchy does not, in itself, result in failure. However, as farms continue to advance through their business and family lifecycles, they need to re-focus their attention. Many will intuitively know that they need to make some changes in their business management functions.

A detailed process that aligns timelines and expectations, outlines what needs to be done and in what specific order and, integrates an implementation function helps farm families attain success.

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FARM FAMILY BUSINESS CONSULTANT PEER GROUP – A REVIEW

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Abstract

It was not long ago when farmers were expected to be able to 'do everything' on their farm. A farmer's broad skill set and abilities were directly connected to their strong sense of independence. Today, things are changing and while the foundation of multiple management skills sets still exists, it is far less common. There is a truism in business that applies to farming; a business typically outgrows its management. With farms becoming increasingly larger and more complex, the prevailing wisdom is that business-focused farmers cannot be all things to all aspects of managing their business.

There is no one correct approach for filling the different resources required to augment a farmer's management skills. Some resources may already be in place, while others may not be being used effectively. The relationships with resources typically vary from casual, one-off interactions to regular and periodic. Management consultants or advisors can help with identifying and selecting appropriate resources. But there are inherent challenges that the management consultants themselves must address.

Businesses are challenged to find consultants who have the multiple skill sets and experience to meet their specific needs. A multi-disciplinary approach is often the consultative model that best serves the family business.

Farm businesses are often located in rural areas and business focus can be regional due to weather and soil types. The owners are generally the managers, and government subsidies and estate tax laws have helped to create the need for complex business structures. These dynamics result in a unique set of challenges in selling, pricing, collaborating and delivering family business consulting services.

Farm families must have the confidence that the professional resources they are utilizing are providing them with unbiased information, the expertise required to meet their specific needs and complete transparency.

Keywords: family, farm, management, peers, consultants, advisors

1. Introduction

It was not long ago when farmers were expected to be able to 'do everything' on their farm. A farmer's broad skill set and abilities were directly connected to their strong sense of independence. Today, things are changing and while the foundation of multiple management skills sets still exists, it is far less common. There is a truism in business that applies to farming; a business typically outgrows its management. With farms becoming increasingly larger and more complex, the prevailing wisdom is that business-focused farmers cannot be all things to all aspects of managing their business.

A challenge for management lies in the subtleness of growth. There is no magic indicator that says when they get to a certain size or to a certain organizational structure that they must adopt specific practices. The requirement to introduce new management practices is more specific to the individual than it is to increasing size or structure. Ideally, management upgrades should be aligned with the demands associated with growth.

There is no one correct approach for filling the different resources required to augment a farmer's management skills. Some resources may already be in place, while others may not be being used effectively. The relationships with resources typically vary from casual, one-off interactions to regular and periodic. Management consultants or advisors can help with identifying and selecting appropriate resources. But there are inherent challenges that the management consultants themselves must address.

Farm businesses are located in rural areas and business focus is often regional due to weather and soil types. The owners are often the managers, and government subsidies and estate tax laws have helped to create the need for complex business structures. These dynamics result in a unique set of challenges in selling, pricing, collaborating and delivering family business consulting services.

The farm crisis of the 1980's, the general shift of population to urban areas, and the retirement of the baby boomer generation has created significant demand for peer group members in the area of management consulting, including succession and ownership planning. Agriculture has been one of the few bright spots during the global recessionary period, with land values and commodity prices at all time highs, fueling consolidation and attracting many financial services firms to offer succession and estate oriented products and services; often with very little knowledge about the industry.

Businesses are challenged to find consultants who have the multiple skill sets and experience to meet their specific needs. A multi-disciplinary approach is often the consultative model that best serves the family business.

Familybusiness.ag came together to work on two areas:

- Develop a collaborative network to enhance each individual's ability to provide services, and
- Uphold the integrity of a process-oriented, systems-based, multi-disciplinary family business consulting process.

Familybusiness.ag spent considerable time thinking about peer group processes and their application to family business consulting. This paper examines why and how Familybusiness.ag developed a peer group of agriculture family business consultants focused on learning from one another, enhancing each person's services, and creating success for family farms in North America.

1.1. History

Familybusiness.ag members met for the first time on April 25-26, 2012 following a discussion at a conference between two of its founding members. They observed individuals, at the conference, who seemed to be abusing the privilege of labeling themselves agriculture consultants in order to sell products and services to farm families who were under the duress of changes within the family farm.

A short list of colleagues, who they respected and trusted and whose presence would add value to the discussion, were invited to explore developing a peer group that represented multi-disciplines of agriculture consulting. Much like their clients who benefit from being part of a peer group, it was their opinion that they would benefit from collaborating with other farm family advisors. They invited six others to join a select group of professionals at informal discovery discussions. They were chosen based on your service deliverables, professional integrity, and aptitude. The original invitees were:

Dick Wittman	Wittman Consulting	Idaho
Barb Dart	GROW: The Family Business Advisors	Michigan
John McNutt	Latta Harris	Iowa
Nick Houle	CliftonLarsonAllen	Minnesota
Terry Betker	Backswath Management Inc.	Manitoba, Canada

Hubert Brown	Kennedy & Coe	Kansas
Lance Woodbury	Lance Woodbury Family Consulting	Kansas
Joe Kluender	Farm Family Dynamics	Minnesota

The goal of the meeting was to research the possibility of an international consortium of farm family advisors who trust each other and carry a high level of standards in the agriculture consulting community.

There was no obligation and if anyone did not feel comfortable with the group they could excuse themselves at any time. A preliminary code of conduct was agreed upon prior to the meeting, including each member declaring a vow of confidentiality regarding everything said and/or implied during discussions.

The outcome of the meeting was a commitment to develop and participate in a peer consulting group. The first meeting identified common goals:

- to provide a forum for networking, information gathering and collegiality among like-minded professionals in order to assure continuity of a qualified base of consulting capacity that preserves the knowledge, experience and integrity of peer group membership,
- to be a center of influence for advancing the adoption of effective best practices of family business management, and
- to work to ensure quality and integrity of the family business consulting profession.

1.2. Charter for familybusiness.ag

"Sharing a passion for developing farm family business excellence."

1.3. Mission

Familybusiness.ag will provide a forum for agricultural family business consulting professionals to share knowledge that will advance our consulting skills and empower our successors with the knowledge, experience and integrity of our peer-group members.

1.4. Vision

We will be recognized as the thought leaders and pre-eminent providers in the agricultural family business consulting profession. Accomplishment of this vision will be evidenced by the following landscape:

- Capable and credible consultants are available in adequate supply.
- Media outlets come to us for comment and content in agriculture-related family business advising.
- Constituents value our integration of a broad array of disciplines, such as finance, human resources, management, legal, and accounting, into the consulting service delivery process.

1.5. Values and relationships

Familybusiness.ag members are sensitive to relationships that exist within their constituencies both as a peer organization and individually. They target and value relationships with diverse networks including accounting, banking and credit, life insurance, legal, local and global consulting organizations, producer groups, academia and government. In relationships with others, members wish to be viewed as: a peer group of legitimate, competent, and seasoned consulting professionals, expert resources in client services, programming, education, and speaking opportunities.

They are not focused as overly competitive or redundant and, maintain positive relationships that, individually and collectively, enable members to:

- Convey a broad, discipline-based "systems" focus in their delivery approach, and
- Leverage the strategic advantage of the network's image to complement individual efforts.

Familybusiness.ag differentiates personal and group motives and priorities. When speaking, delivering services or participating in events, members will represent themselves first as individuals and, second as affiliated with fam*ilybusiness.ag.* Members are expected to mutually promote each other's endeavors. Benefit derived from association with the professional network is the primary compensation expectation and does not include additional financial compensation from the group or expected referrals. Any member who does not see reciprocal benefits should terminate membership.

1.6. Criteria for membership

Prospective members must:

- Be sponsored by one or more group members and have unanimous support.
- Have had a proven track record and significant workload focused in agriculture.
- Have a passion for professional development and empowerment of others.
- Have demonstrated emphasis on "understanding process" before selling products and services
- Must have transparency in fees charged.
- Be viewed as capable of challenging and contributing value to the group.
- Establish their qualifications based on their own credentials, not a company affiliation.
- Have a professional affiliation/accreditation in the agriculture family business consulting field or comparable work experience.
- Add to and/or ensure a diversity of disciplines and geographic representation.
- Be willing to demonstrate proficiency related to one or more client experiences in an interview presentation with the Steering Committee.

There are protocols for new members. Recommendations on potential new members from the current member (the sponsor) are posted. Biographies are placed in a Dropbox account. Potential new members are required to submit written responses to questions at least two weeks prior to a familybusiness.ag meeting. New members must describe the kind of work they do and how they approach their work. They must detail an actual client engagement experience and how they succeeded or failed in the engagement. How they measure success, what they expect from familbusiness.ag and what they add to the group must be detailed. They are to describe their thoughts concerning professional development and provide their agriculture industry background. They must indicate how much of their practice is related to agriculture and how they stay educated and informed about the agriculture industry.

There is a defined time limit for a formal interview at a regular familybusiness.ag meeting. Each member takes part in dialogue with potential members, to observe them and get to know the person over the course of the meeting. As a group at the end of the day, or by phone, familybusiness.ag members vote to extend a formal invitation to join the group.

1.7. Rules for attendance, withdrawal or dismissal

There are rules for attendance, withdrawal or dismissal. Attendance: Any member who fails to participate in two consecutive meetings is no longer a member. Dismissal: Any member can withdraw voluntarily. Assets of the group reside with the group. Dismissal can also result from a lack of participation, or a breach of Code of Conduct.

2. Governance structure and standard operating procedures

Governance and standard operating procedures includes committees:

- A Steering Committee is the primary governing body for setting policies, practices and priorities. The committee will consist initially of the eight founding members of the group.
- Other ad hoc committees will be created and staffed at such future date as the organization sees a need to add such committees
- Standard Operating Procedures (SOPs) include meeting leadership, facilitation and expense sharing. Duties and responsibilities of the facilitator are outlined in Appendix A. The facilitator role is rotated each meeting. The facilitator is responsible for organizing and facilitating meeting discussions, based on a set of duties and responsibilities agreed upon by the group.
- Travel and housing expenses are the responsibility of individual meeting participants. Meeting expenses are aggregated by the facilitator and shared on a pro rata basis by those in attendance. Meetings occur every third Wednesday and Thursday in April and October. Meetings are a day and a half, enabling members to travel, attend the meeting and return home in two days.
- The facilitator plans the agenda. A working list or "Parking Lot" of meeting topics and areas of focus is maintained and updated along with a priority ranking at the end of each meeting to guide areas of focus for future meetings and conference calls.

Members use the internet and Dropbox technology for sharing, storing and interaction related to membership communications. Details on the SOPs for accessing and using this communication protocol are outlined in Appendix B.

A Code of Conduct as outlined in Appendix C has been ratified by the membership and is reviewed at each meeting.

Protocols for shared consulting include a policy and operational framework for engagements that may involve multiple members of the peer group. A set of protocols has been developed and attached in Appendix D.

Organizational history, in summary format, of the initial formation as well as key milestones and accomplishments of this group is maintained and updated. The facilitator of the meeting is responsible for assuring this update takes place.

Appendix A – Facilitator Duties

Facilitator duties include:

- Arrange for meeting space, food and drinks, and housing for hosted meeting.
- Provide for meeting equipment if necessary such as a projector, white board and related materials.
- Prepare the agenda.
- Send meeting reminders and agendas to members at least 21 days before the meeting.
- Facilitate the meeting:
  - Start on time,
  - Review the pledge of confidentiality,
  - Lead discussions,
  - Maintain agenda (stay on topic),
  - Hold responsible persons accountable for action items from previous meeting,
  - Include everyone in the conversation,
  - Make sure everyone contributes to meeting,
  - Prevent dominant personalities from dominating conversation/action,

  - Keep notes and send summary of meeting within 10 days,
  - Assign action items,
  - Next meeting:
    - Ensure the date, location and facilitator are set.
  - End on time.
- Manage follow up:
  - Provide a summary of meeting
  - Allocate meeting costs
  - Enable discussions between members between meetings
  - Support the next facilitator in establishing agenda and accountability for action items.

Appendix B – Details for Communications using Dropbox

Familybusiness.ag uses Drop Box technology for shared communications. A folder has been established on Drop Box. New drafts originated by the group should be circulated via email as an attachment and also stored in the Drop Box files. Each member can edit documents stored in Drop Box. Substantive edits use track changes technology, so other members can see the author and nature of edits made. At periodic checkpoints when edit periods are closed, the primary author is responsible for accepting changes. Minor edits can be made to live documents and re-saved at a member's discretion. Members using Drop Box should save documents under the appropriate sub-folders to keep the site from excessive clutter.

Appendix C – Code of Conduct

Familybusiness.ag code of conduct includes:

- Each member has declared a vow of confidentiality regarding everything said and/or implied during the discussions. There will be zero tolerance. If the group losses trust in any member they will no longer be offered a seat at the table.
- The group will operate in a non-competitive nature and give credit to source when sharing resources.
- Members will promote and deliver services not centered on compensation from product sales or commissions.
- All members will represent themselves and not their employer (as applicable).

Appendix D – Protocols for Shared Work

Internal protocols for working with shared clients:

- Any and all communication with the client is the responsibility of and is shared by all:
  - Agree to regular updates of progress on each consultant's front. Updates could be weekly, monthly or at certain intervals, via email or phone, but the key is to agree on a communication standard to keep everyone on the same page.
- Serve the client first, not self or own organization:
  - For those imbedded in larger firms, this one may at times prove difficult, but the key is to focus on clearly understanding and articulating the client's goals, concerns and priorities. Thus, in order to serve the client in some collaborative fashion, members agree to elicit and clearly state what it is the client is intending to accomplish.

- Person who initiates the engagement remains the lead person in charge:
  - Acknowledging that members have a lot of trust and respect for one another, there is a need to make sure that there are discussions about leadership throughout the engagement. It may be appropriate to handoff leadership based on the expertise in the group and it may be important to hand it off again after a certain phase of a project. There may be cases where a client decides to make a change in project or engagement leadership. Members will work to understand what communication and activity has taken place with prior leaders and consulting resources.
- Individual Engagements:
  - Individual engagements should be a first option. However, based on various relationships, it may make sense to propose an overall value proposition to the client. Thus, if the engagement is not based on an individual engagement, members must describe, in writing, the fee sharing arrangement and make the client aware of it.
- Members bill their own work:
  - Members billing their own work should be a first option. Caveats may occur where a shared fee arrangement makes sense. Absolute transparency with the client about a member receiving any form of compensation from a referral relationship, product sale or brokerage must be evident.
- Deliver on time:
  - Members agree that delivery on time and against agreed-upon deliverables is required.

There are external protocols for working with other advisors. Many of the professionals that interact with farms and family businesses are generalists. Sometimes that is a satisfactory resource. However, at other times farm families need a level of complexity that requires a specialist. Familybusiness.ag intention is to provide the best solution for a client's family business, and that may require consultation with other professionals that have a deeper knowledge base than their local advisor.

Familybusiness.ag members' work often depends on the timeliness and accuracy of other's work. To that end, members must let other professionals know what is expected of them and, vice versa. Expectations must be set around timelines and deliverables. Parties are to hold one another accountable to excellent work, product and process.

Many advisors have a long history with the families and businesses that familybusiness.ag members may work with. Members must respect that history, first by telling them what is expected from their relationship(s), and second by treating them similar to how members would treat the client – namely, by seeking their input – even if not the most efficient way to complete a project. In other words, they may not have much to add to the work that has been completed by a familybusiness.ag member but it may be advantageous to look for ways to encourage their ownership of the end result. This might include showing them a draft of documents, including them in meetings, or calling to let them know the progress and asking if they have anything to add.

3. Conclusions

Farms and agri-businesses are challenged to find consultants who have the multiple skill sets and experience to meet their specific needs. A multi-disciplinary approach is often the consultative model that best serves the family business. Consultants and advisors are required to maintain their professional capabilities. These capabilities are usually very specific. It is challenging, if not nearly impossible, to maintain currency in and across the multiple of professional disciplines as required in farm family situations. Familybusiness.ag is a first step in bridging the multi-discipline, professional gap that sometimes exists.

AGRICULTURAL LENDER EDUCATION CAN DIRECTLY AND INDIRECTLY MULTIPLY RISK MANAGEMENT EDUCATION EFFORTS

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Abstract

Ohio State University Extension professionals organize and teach one-day agricultural lender education seminars annually focused on management and broader industry topics affecting agriculture in the United States. While the three seminars in 2012 reached 97 agricultural lenders, these lenders reported having 9,500 farm customers with whom they plan to share the knowledge gained from OSU Extension. Knowledge gained was measured by using a retrospective pre/post survey instrument that lenders self-measured their before and after knowledge on seminar topics. Lenders improved their knowledge in risk management topics measured by a retrospective pre/post questionnaire using a six point Likert scale. Knowledge was gained on all seminar topics and ranged from 1.08 gain (Ohio Livestock Care Standards) to 1.90 gain (New Dairy Technologies). Knowledge gained will be used by lenders directly (speak with customers related to their farming operation), indirectly (use to review customer portfolios), and as background (professional development and industry awareness) with their farm customers. Three topics were identified as having high percentage of lenders directly using knowledge gained with customers: Farm Transition Planning Rational to Reality (76%), Examining Potential Profitability for 2013 (66%) and Returns to Farm Drainage (60%). Two topics were identified as having high percentage of lenders using knowledge gained as background use with customers: Many People and Less Poverty in 2050-Feeding the World (66%) and Ohio Energy Development-Wind, Solar, Gas (55%). Knowledge gained by lenders will reach a diverse demographic of farm customers based on the $2.5 billion agricultural portfolio reported by participating lenders. Participating agricultural lenders indicated that OSU Extension can best serve lenders and their customers by offering unbiased information for farmer customers, being a resource for lenders and providing updates, providing current trends in the agricultural industry and continuing extension at the county level. By evaluating the 2012 seminar participants, OSU Extension educators better understand the important multiplier effect of teaching a group of professional agricultural lenders and reaching nearly a hundredfold the number of Ohio farmers with the educational information.

Keywords: risk management, education multiplier, agriculture lenders

1. Introduction

Large commercial farms in Ohio continue to expand and the need for accurate information is more important than ever. Coinciding with this changing farm structure is a reduction in Ohio State University Extension educators, especially in the farm management education arena. One of the methods adopted by OSU Extension was to target farm management educational programming toward agricultural professionals that work directly with farmers. Although, this type of program has been offered for several years in Ohio, in 2012, program was expanded and the evaluation was targeted at measuring the multiplier effect of these educational efforts.

The educational objective of the Ohio State University Extension's Agricultural Lenders Seminar is to improve the knowledge and/or awareness of Ohio's agricultural lenders. This objective is accomplished through offering an annual professional development seminar delivering research-based information to lenders based on the identified needs or information gaps of the participants and current issues identified in the agricultural industry by faculty in the Ohio State University's College of Food, Agricultural, and Environmental Sciences.

2. Procedure

Ohio State University Extension professionals have organized professional development seminars for agricultural lenders for several years. Professional development seminars for agricultural lenders in Ohio have become the responsibility of county based personnel because of the loss of district, regional and state Extension specialists. In the past three years, two seminars were held in each 2010 and 2011. A new third location was added for 2013. Seminar locations are strategically identified to compliment repeat attendance and develop new participation.

Determining the topics, covered each year at the Ag Lenders Seminar, is a grassroots effort led the program organizers. County based Extension educators contact agricultural lenders in their respective geographic area to collect input into the issues facing agriculture. Seminar topics are selected based on the needs and knowledge gaps identified during agricultural lender pre-seminar interviews and post-seminar evaluations. The core topics of the seminars focus on macro and micro economic issues. Most common and highly valued micro economic topics are OSU research on production enterprise budgets, cropland values and rental rates, market forecasts for crops, livestock and dairy, and outlook on input costs such as seed, chemicals, and fertilizers. Somewhat related, macroeconomic topics commonly presented are U.S. and global financial forces, trade and policy issues and world demographics related to food and energy production. However, not all topics are directly economic in nature. Seminars have been customized to discuss robotic milking parlors, global positioning systems and precision agriculture, water quality, animal production care standards, stress management in farm families, and oil/gas/wind energy development.

Seminars are one-day events that are taught by OSU Extension professionals and professional guests. The 2012 seminars were taught with four topics as the core of the agenda with each location adding local or regional topics. The presentations are face-to-face lectures allowing discussion and interaction between the speaker and the engaged audience. Core topics typically have one hour of time while other topics range from 20-40 minutes. Printed material is also made available to the participants that complement the speaker topics and/or a related university publication or resource helpful to lenders. Scheduled break and lunch times provide opportunity for speakers to interact with participants, informal discussion and one-on-one teaching. Seminars have provided a unique professional development opportunity for Ohio's agricultural lenders. In 2012 the invitation was also extended beyond the lender to include upper bank management and bank board members.

3. Post Program Results – direct impact

Annual attendance in the last three years has been 66, 92, 97 for 2010, 2011 and 2012, respectively. In 2012, across all locations, 32% of the participants were first time attending, 41% had attend 2-9 previous seminars, while 27% had attended 10 or greater previous agricultural lender seminars delivered by OSU Extension. The 2012 lenders' response to "overall usefulness" of seminar to their business on a scale of Not Useful (1) to Extremely Useful (6) across all locations was a weighted average by attendance of 4.65. Seminars have provided a unique professional development opportunity for Ohio's agricultural lenders.

To develop meaningful impact outcomes of the seminars, extension educators developed a retrospective pre/post evaluation instrument to collect data using a six point Likert scale to measure participant knowledge gain. Participants were asked to rate their knowledge on the topics prior to the seminar and immediately following the seminar. Evaluation results showed that there was knowledge gained on all topics presented at the 2012 Ag Lenders Seminars (Table 1).

Table 1. Knowledge Gained as Reported by Pre/Post Evaluation

Pre-Test	Topic*	Post-Test	Knowledge gain
2.62	New Dairy Technologies (Wooster)	4.52	1.90
3.20	Returns to Farm Drainage (Ottawa)	4.90	1.70
2.77	Many People/Less Poverty (All)	4.17	1.40
2.98	Future Fertility Resource Needs (All)	4.27	1.29
3.72	Farm Transition Planning (All)	5.00	1.28
2.33	Ohio Energy Development (Chillicothe)	3.58	1.25
3.70	Crop Profit Potential 2013 (All)	4.80	1.10
3.50	Ohio Livestock Care Standards (Chillicothe)	4.58	1.08
3.10	Ohio Farm Business Summary (Wooster)	4.17	1.07

* Not all topics were presented at each location. Locations are in parenthesis following the topic.

An examination of the results show that participants had greater knowledge on the topics of farm transition planning, crop profit potential, and Ohio livestock care standards. Areas with lesser knowledge included Ohio (renewable) energy development, new dairy technologies, and population growth and poverty. The participants reported the most knowledge gain in the areas of new dairy technologies and returns to farm drainage, while reporting the most overall knowledge at the conclusion of the seminar in the areas of farm transition planning and returns to farm drainage.

4. Post Program Results – indirect impact

Knowing how much knowledge the participant gained or possesses is not all that useful other than measuring the effectiveness of teaching. The real issue is what the agricultural lenders will do with the knowledge. Extension educators also found that information taught will be used by lenders directly (speak with customers as it relates to their farming operation), indirectly (use information to review customer portfolios), and as background (professional development and industry awareness) with their farm customers.

Three topics were identified has having high percentage of lenders directly using knowledge gained with customers. They were farm transition planning (76%), crop profit potential (66%) and returns to farm drainage (60%). Two topics were identified having high percentage of lenders using knowledge gained as background use with customers: Many people and less poverty (66%) which focused on long term population trends and food production trends, and Ohio energy development (55%) which addressed renewable energy trends and opportunities locally. Other topics, identified has having a balanced use by lenders between direct, indirect and background use, include future fertility resource needs, Ohio livestock care standards, new dairy technologies, and the Ohio farm business summary (see Fig. 1).

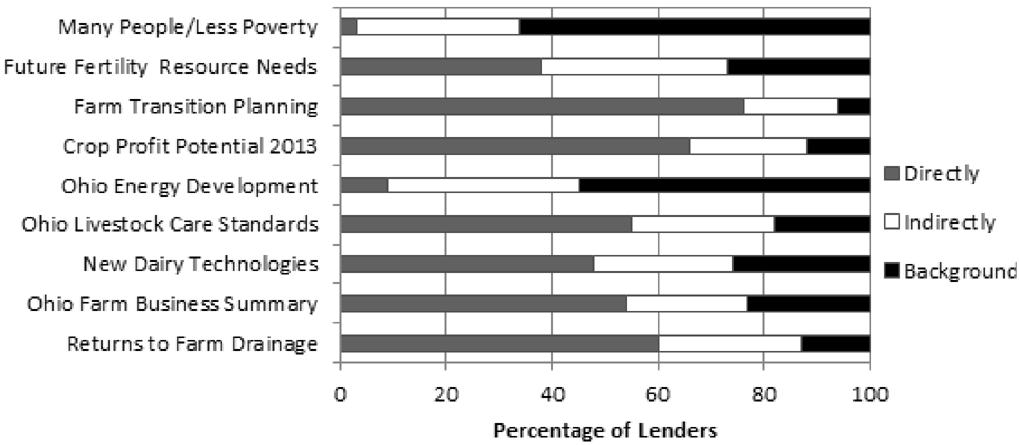

Figure 1. Agricultural Lenders Use of Knowledge Gained

How many people will be reached as a result of the Agriculture Lenders Seminars conducted by Ohio State University Extension? The 2012 seminars reached 97 lenders and the lenders reported having 9,500 farm customers that they would serve with knowledge gained from OSU Extension. Over the recent three years, knowledge gained by lenders supports agricultural portfolios of over $2.6 billion annually. The total agricultural portfolio reached in 2012 was farms producing grain only (48%), dairy/livestock only (15%), grain and livestock (13%), specialty crops (11%), small and beginning farms (11%), agribusiness (1%), and rural housing (1%).

5. Conclusions and implications

Reaching the farm audience will require OSU Extension and other educators to utilize multiple avenues in today's complex farm business world. The targeting and education of agricultural lenders is just one example of utilizing agricultural professionals serving the farm manager to provide educational information. In this model, OSU Extension was successful in multiplying their efforts through the agricultural lender in reaching the farm managers. Another benefit of teaching agricultural lenders was follow-up invitations from these lenders to Extension educators to speak directly to their clientele on the seminar topics.

Participating agriculture lenders indicated that OSU Extension can best serve lenders and their customers by offering unbiased information for farmer customers, being a resource for lenders and providing updates, providing current trends in the agricultural industry and continuing Extension at the local level. As a result of evaluating the agricultural lenders participating in the 2012 educational seminar, OSU Extension educators better understand the important multiplier effect of teaching a group of professional agricultural lenders and reaching over a hundredfold the number of Ohio farmers.

IN PURSUIT OF SUSTAINABILITY: THE USE OF THE BUSINESS PLAN AS A MANAGEMENT TOOL FOR GROWERS

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Abstract

The Sustainable Sugarcane Farm Management System SUSFARMS® proposes that for the "Prosperity" pillar to be upheld, both a detailed agronomic and financial plan need to be put in place. This can be achieved through the development of a comprehensive business plan which provides an assessment of the farm business intervention requirements in order to develop the farming enterprise which include: crop establishment, infrastructure development, mentoring, capacity building, and other assistance in the daily operations of the business. This re-establishment of the farm economic infrastructure is essential to provide a base for sustained profitability. The paper stresses the important role of the entrepreneur who has to take responsibility for the plan and treat it like a living document which can, with assistance of skilled agronomic and economic extension staff, be used as an invaluable management tool to guide decisions on various aspects of the farming business.

Keywords: sustainability, business plan, management tool, land reform

1. Introduction

The concept of sustainability in the agricultural setting has gained significant momentum over the past decade. There is a growing recognition that if on-farm production is to be sustained, and indeed enhanced, into the future, three interrelated goals need to be pursued concurrently, namely; environmental health, economic viability, and social and economic equity. The South African sugarcane industry is no different and it is upon this premise that SuSFarMS, The Sustainable Sugarcane Farm Management System, is built (Maher, 2007; Sustainable Sugar Initiative, 2008). The system is designed to encourage sustainable sugarcane production through the implementation of better management practices (BMPs), which reduce the negative impacts on the environment whilst ensuring economic sustainability and social upliftment. The system is built upon three pillars, namely; (i) Prosperity (economic principle) – economically viable sugarcane productions is maintained or enhanced; (ii) People (social principle) – the rights of employees and local community are upheld and promoted; and (iii) Planet (environmental principle) – natural assets are conserved, critical ecosystems services are maintained and agricultural resources are sustainably used.

This paper focuses on the first of these three pillars, the principle of prosperity, which aims at enhancing economically viable sugarcane production. This is achieved, in part, through the development of an annual production plan (agronomics) and an annual financial plan (economics). Thus an optimum balance between agronomics and economics is sought in order to maintain or enhance production.

2. Land reform in the South African sugar industry

In 1994, the ANC led Government introduced a land and agrarian reform programme to redress the injustices and legacies inherited in the land and agrarian sectors under the apartheid regime (marked by widespread dispossession, and rural poverty), and, by redistributing land to black South Africans, to transform the structural basis of racial inequality (Hall, 2004; Thomson and Gillitt, 2007). The land reform programme is implemented in two key forms, namely; (i) land redistribution – whereby land is transferred through the pro-market willing seller-willing buyer principle (a completely voluntary transaction between a buyer and a seller), and (ii) land restitution – whereby land is returned to people who were dispossessed post-1913, which marks the year of the first Land Act, which legalised land dispossession on a large scale. This has created a new class of black commercial new-entrant farmers. Given their unfortunate history, these beneficiaries often lack knowledge and expertise in both managing the agronomic and financial aspects of the business, making them sensitive to even the smallest economic shocks (DAFF, 2011). Given their apparent vulnerability, this paper uses land reform growers as a case study to explore the usefulness of a business plan as a management tool aimed at promoting sustainable agricultural businesses – with specific reference to the South African sugar cane industry.

A fundamental element of land reform is sufficient support to assist the new land owners to become productive users of such land. This comes in the form of post-settlement support which may involve provision of finance, farming inputs, information and training, etc. Recently (2011) the South African government, through the Department of Rural Development and Land Reform (DRDLR), has showed a strong commitment to the sustainability of farms transferred to land reform beneficiaries since 1994 with the introduction of the Recapitalisation and Development Programme (RADP). Due to lack of working capital, capital equipment, management skills and institutional support amongst other factors, there been significant decline in yields post transfer on many of these farms. This program is aimed at revitalising these "distressed" farms and, vitally, aims to ensure that the farming businesses remain self-sustainable into the future. The sugar industry is participating in the RADP Programme by acting as Strategic Partners or Mentors (generally performed by the various milling companies), and by providing project management and technical support at no cost to the beneficiary. Arguably one of the most important components of the industry support has been the commitment of resources to the process of business plan development – essential if the programme is going to be successful in the long-term. CANEGROWERS as the economic advisors to growers', has undertaken this activity.

3. The business plan

It is important from the outset to clearly define what a business plan represents and its purpose. DAFF (2011, p. 2) defines a business plan as a "plan of how a business owner, manager or entrepreneur intends to organise an entrepreneurial endeavour and implement activities necessary and sufficient for the venture to succeed". Key to this definition is the fact that ownership of the business plan lies with the entrepreneur. Experience has shown that as soon as a business plan is viewed simply as a gateway to access government funding, the real value of the document is lost, destined to be shelved the moment funds are approved. Rather, a business plan should be viewed as an essential tool for planning, direction and running a business. Indeed, the document clarifies the operational and financial objectives of a business and contains the detailed plans and budgets showing how the objectives are to be realised, resulting in a profitable and sustainable business. Accordingly, the purpose of the business plan is to quantify all the required interventions to make the farming business profitable, and to plan how these interventions will be budgeted for in the next five to ten years.

The reason for preparing a business plan varies according to the needs to be addressed at a certain point in time. Accordingly, a business plan may be internally or externally focused. An internally focused business plan will talk to the business intermediate goals required to reach the external goals, while an externally focused business plan seeks to convince an external funder (government or financial institutions) that the business has the means to ensure that it is profitable and sustainable and able to make repayments (if applicable). Indeed, in regard to RADP, a credible and bankable business plan which defines a path to reach sustained profitability of the enterprise is a prerequisite for access to funding.

4. Sustainability requires people, planet and prosperity be addressed

In the sugarcane industry, the business plan development process has been led by CANEGROWERS given that its expertise lies in the economics of sugar cane production. However, a business plan, by its very nature, requires a multidisciplinary approach. Particularly in the land reform context, the focus cannot not lay solely on enhancing yields and grower returns, but must concurrently address institutional arrangements, social challenges, organisational arrangements and farm business management and related training requirements to ensure long-term sustainability. To achieve this, CANEGROWERS regional staff collaborate closely with their counterparts in SASRI (agronomic specialists), milling companies (extension support), and SASA (social facilitation & institutional support). Crucially, the entrepreneur is also involved in, and contributes to, the process. This not only provides a key learning opportunity for the entrepreneur, but also helps create a sense of ownership which in turn enhances that probability of successful implementation and on-going monitoring and evaluation.

Having reviewed social, institutional and organisational aspects to ensure that the business is correctly placed and structured to conduct business, a forward-focused production plan needs to be developed noting interventions required to achieve this plan. Focus is typically on medium- to long-term interventions that will improve the profitability outlook of the farm business. The priorities on the farm are ascertained by key industry stakeholders including SASRI extension staff. From an agronomic stand point these generally include:

- Resource assessment (physical, climate, soils, topography, historical prod.).
- Cane root analysis – age disposition.
- Immediate replanting needs analysis (including variety recommendation).
- Assessment of infrastructure needs.
- Assessment of machinery and equipment needs.

This process needs to be carefully managed and “wants” and “needs” must to be clarified and priority allocated to those aspects which enhance the revenue generating and/or cost saving attributes of each farm business that are within the scope of the business requirements. Typically, priority is given to replanting of cane roots as these are the key to enhance and sustain the revenue generating capacity of the farm. A cane root disposition analysis is completed and an opinion of cane replanting requirements is obtained from a SASRI Extension (Agronomic) Specialist. The ability and capacity of the farm business resources as well as the availability of any external resources required must be considered in order to determine the extent of planting in any particular year.

When considering machinery and equipment requirements, focus is on usage that will be economically sustainable at the expected farm production levels and where the management capacity on the farm will be able to efficiently manage and maintain the equipment (a SASRI Mechanisation Guideline has been developed to simplify decision making in this regard) – in absence of this capacity alternative options will be presented to the grower, such as the use of contractors. Similarly, infrastructure that directly contributes to the economic sustainability of the farm (e.g. enables better efficiencies, reduces costs or increases revenue) will be allocated funding in the financial plan.

Throughout this process the entrepreneur will be involved, providing a unique opportunity for him/her to fully consider his/her management options on the farm. Key planning tools in this process should include SUSFARMS® (2012) (through the implementation of BMPs), variety disposition plan, biosecurity plan and, if grower is a new-entrant, a farming calendar to identify the correct timing of various farming operations. Indeed, successful cane farming is about doing the right thing at the right time and having the funds to pay for it. Accordingly, the aforementioned planning process is then consolidated into a 5- to 10-year production plan which is the key input into the financial plan. This then integrates the three principle requirements of SUSFARMS (2012).

The financial plan should, as with the other aspects of the business plan, be drawn up in close consultation with the farming representatives and every effort should be made to ensure the accuracy of the financial information. Whilst CANEGROWERS has developed a financial model template which provides the basis for the cost structure and can be used to guide the discussion, it is understood that every farm business is unique and thus customisation is to be expected in each project. Of equal importance is to ensure that all debt obligations are included in the budget. These include bonds, hire purchases and medium-term/seasonal loans – including any outstanding tax obligations. This information is important in order to assess the ability of the farm to meet all debt obligations under a normal/optimal production scenario. The cost of management and drawings must also be considered – in certain cases the owner may simply draw a management salary that covers personal needs, but in others, a manager may be hired as well as the owner taking drawings – this should be included to ensure that the farm business will cover these needs.

Many growers find record-keeping an arduous task but for the many land reform farming businesses such information is often not easily available, with record keeping systems either absent entirely or incomprehensive. Indeed, in some instances bank statements are the only available guiding documents. It is vital therefore that the entrepreneur is coached on the importance of record keeping. This in turn will significantly simplify cash flow budgeting that is to be conducted on an on-going annual basis, with assistance from CANEGROWERS staff.

The financial plan essentially fulfils the purpose of the business plan by quantifying all the required interventions identified to make the farming business profitable, and shows how these interventions will be budgeted for in the next five to ten years. Drawing on the resource assessment and production plan, and utilizing current cost and revenue estimates, which are largely based on a combination of data received from CANEGROWERS' industry averages as well as in consultation with the owner/manager, a ten year cash flow projection is developed. In addition, the first five years cash flow projection is analysed in more detail to ensure that there is sufficient working capital in the early years, particularly if significant replant is required which is associated with a heavy financial burden in the in the short term – especially is case where there is limited or no grant funding available. Hence the importance of component cost functions (planting, rationing etc.) required to identify the source of any cash flow pressure. Scenario analyses may also be performed with the owner/manager showing comparisons between normal and optimum production, equipment ownership vs. use of contractor, enterprise diversification choices etc.

The financial plan should be used to plan the long-term development and sustainability of the farm business. Upon completion, the detailed financial plan, as well as a summary for ease of reference, is appended to the business plan write-up. This financial plan, incorporating the production plan and associated costs of required interventions can then be presented to the implementing agent (Strategic Partner) once the business plan has been approved. Monitoring and evaluation of the implementation process then becomes of vital importance as a good plan with poor execution is as damaging as a poor plan! CANEGROWERS economic advisors are all qualified to fulfil this function.

To facilitate this monitoring and evaluation, the industry has instituted Land Reform Development Committees in each of the growing regions. These committees compromise of various government departments, growers, millers and economic and agronomic extension staff; thereby representing a comprehensive and diverse set of skills and experience in the sugar industry readily at its disposal. The primary aim of the Committee is to provide all stakeholders with a platform for structured and constructive communication, coordination, cooperation and information sharing concerning the effective implementation of land and agrarian reform in the region. Accordingly, the Committee is essential in the monitoring and evaluation process the various Land Reform projects, and facilitates transparency, efficiency and effectiveness of implementation plans as detailed in the respective business plans, as well as promoting developmental outcomes and long-term sustainability of the Land Reform programme.

Once the farm has been redeveloped and reaches an optimal level of productivity, it is essential that best management practices are followed (such as maintaining at least a 10% annual replant programme) in order to maintain productivity. This will also require sound financial management and responsible budgeting and spending. Economic and agronomic extension is available to assistance in this regard, but it is up to the entrepreneur to take full advantage of this support. Indeed, the financial plan prepared as part of the business plan should be seen as a living document, updated in line with changes in financial position, agronomic developments and production expectations, amongst others. Updated on a regular basis, this represents an invaluable management tool, as it cuts across all aspects of the business and enables the entrepreneur to predict the impact that any particular internal or external change may have on farming business as a whole, and to adapt accordingly.

5. Conclusions

The Sustainable Sugarcane Farm Management System proposes that for the "Prosperity" pillar to be upheld, both a detailed agronomic and financial plan need to be put in place. This can be achieved through the development of a comprehensive business plan which provides an assessment of the farm business intervention requirements in order to develop the farming enterprise which include: crop establishment, infrastructure development, mentoring, capacity building, and other assistance in the daily operations of the business. This re-establishment of the farm economic infrastructure is essential to provide a base for sustained profitability.

The paper has stressed the importance of the entrepreneur taking ownership of his/her business plan and treating it as a living document which can, with assistance of skilled extension staff, be used as an invaluable management tool to guide decisions on various aspects of the farming business.

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TRANSFERRING KNOWLEDGE AND EXPERIENCE TO STRENGHTEN THE AGRICULTURAL INDUSTRY: STEP UP™ – A MENTORSHIP PROGRAM FOR CANADA'S FUTURE FARM MANAGERS

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Abstract

In the realm of knowledge transfer, our thoughts primarily turn to academic and scientific communities and the transfer of theoretical research into practical terms. And, while we have a solid appreciation for the importance of farm transfer and succession for the ongoing prosperity of the agricultural industry, oftentimes our sentiment is limited to matters pertaining to finance and legalities. However, in the agricultural context especially, knowledge transfer must also relate to the transfer of inherent knowledge and experience of one generation of farmers to the next. Intellectual capital must be placed in greater consideration in order for Canada's future farmers to stand on the shoulders of giants – a foundation from which to secure Canada's agricultural industry, and a platform from which to launch into continued prosperity and success. Young farmers and new entrants are the future of the Canadian agriculture industry. In order to succeed in knowledge transfer however, we must be conscious of the learning preferences and practices of the apprentice, in order to receive, apply and prosper from the knowledge gained - to ultimately change behaviour at the farm level. While we have succeeded in providing experiential learning in production techniques, we must also consider how we can embrace experiential learning to successfully transfer business management skills and best practices amongst the farming community. The success of any farm enterprise is directly related to the business-management skills of the farm manager. This paper focuses on Farm Management Canada's STEP UP™ Mentorship program as an example of a practical approach to business skills development. STEP UP™ is an on-farm learning placement that matches experienced farmers with beginning, new, potential and transitioning farmers to learn critical aspects of farm business management in a hands-on setting.

Keywords: farm, management, succession, transition, education, Canada

1. Introduction

In the realm of knowledge transfer, our thoughts primarily turn to academic and scientific communities and the transfer of theoretical research into practical terms. And, while we have a solid appreciation for the importance of farm transfer and succession for ongoing prosperity of the agricultural industry, oftentimes our sentiment is limited to matters pertaining to finance and legalities.

However, in the agricultural context especially, knowledge transfer must also relate to the transfer of inherent knowledge and experience of one generation of farmers to the next. Intellectual capital must be placed in greater consideration in order for Canada's future farmers to stand on the shoulders of giants – a foundation from which to secure Canada's agricultural industry, and a platform from which to launch into continued prosperity and success.

Young farmers and new entrants are the future of the Canadian agriculture industry. In order to succeed in knowledge transfer however, we must be conscious of the learning preferences and practices of the apprentice, in order to receive, apply and prosper from the knowledge gained to ultimately change behaviour at the farm level.

Farmers are often “show-me” types who respond to learning in a practical, tangible way, and cherish the advice of other farmers in adopting best practices.

While farmer mentorship is not a new concept, Canada’s programs typically focus on production skills. And, while we have succeeded in providing experiential learning in production techniques, we must also consider how we can embrace experiential learning to successfully transfer business management skills and best practices amongst the farming community.

The success of any farm enterprise is directly related to the business-management skills of the farm manager.

Farm Management Canada’s STEP UP™ Mentorship program has taken a practical approach to business skills development through on-farm mentorship, with a focus on first-hand farm management experience. STEP UP™ is an on-farm learning placement that matches experienced farmers with beginning, new, potential and transitioning farmers to learn critical aspects of farm business management in a hands-on setting.

FMC is helping build a culture of lifelong learning and farm business management for beginning farmers, established farmers and for those in sectors in transition by providing the necessary tailored tools and resources to meet changing needs and realities.

2. The future of Canada’s farmers: rising age, complex farms, shifting assets

Table 1. Average operator age of the canadian farmer

Province	Average operator age		
	2011	2006	2001
Newfoundland and Labrador	55.0	52.3	50.5
Prince Edward Island	54.2	51.4	49.3
Nova Scotia	55.4	53.2	51.0
New Brunswick	55.5	52.8	51.0
Quebec	51.4	49.3	47.0
Ontario	54.5	52.6	50.7
Manitoba	53.1	51.2	49.0
Saskatchewan	54.2	52.6	50.5
Alberta	54.5	52.2	49.9
British Columbia	55.7	53.6	51.4
Total Canada	54.0	52.0	49.9

Source: Statistics Canada, Census of Agriculture, 2001 to 2011

The average age of the Canadian farmer is rising. Statistics Canada’s 2011 Census of Agriculture1 observed the average age of the Canadian farmer has risen by 2% to 54 years of age, compared to 52.0 in 2006 and 49.9 in 2001.

The rising age of Canada’s farmers indicates an immense shift of vast amounts of farm assets through farm succession and transfer in the next ten years. Furthermore, Canada’s farms are becoming increasingly complex.

According to the latest Census, the average size of a Canadian farm has increased by 6.9% since 2006, while farms with $500,000 and over in gross farm receipts account for 11.5% of farms in 2011, compared to 8.6% in 2006. And, farms with $1 million or more in gross farm receipts increased significantly from 3.2 to 4.7% of farms in Canada.

Small or large, farm diversification is leading to complex farm businesses with many farms running diverse business streams within the farm business including retail outlets and custom contracting, to name a couple examples. And, as farms become increasingly complex, farmers must maintain a diverse skill set to manage operations. It is vitally important to have a mechanism for today’s Principal Decision Makers (PDMs) to pass this vast, diverse knowledge onto the succeeding generation.

[1] 2011 Census of Agriculture, Statistics Canada. <http://www.statcan.gc.ca/ca-ra2011/index-eng.htm>

Therefore, asset transfer to Canada's future farmers is not limited to financial assets, but also includes knowledge and experience – passing on lessons learned and best practices to the succeeding generation and new entrants.

This begs the question, *Are agriculture's new entrants and the next generation of farmers prepared for the responsibilities that come with managing Canada's agricultural industry?*

2.1. Working together makes sense

Statistics Canada's 2011 Census of Agriculture indicates an increase in gross farm receipts when younger (under 35 years of age) and older (over 35 years of age) generations worked together on a farm operation. The table below shows average gross farm receipts almost double for farms with under-35 operators alongside over-35 operators versus farms with all operators under 35 years or farms with all operators over 35 years of age. This indicates the need for the younger and older generations of farm operators to be working together and learning from one another.

Table 2. Gross farm receipts and number of farms

Gross farm receipts	2011	2006	Percent change 2006 to 2011
	number of farms		
Less than $10,000	43,95	45,749	-3.9
$10,000-$24,999	32,85	36,971	-11.1
$25,000-$49,999	25,76	30,227	-14.8
$50,000-$99,999	25,46	31,119	-18.2
$100,000-$249,999	31,67	40,382	-21.6
$250,000-$499,999	22,46	25,108	-10.6
$500,000-$999,999	13,98	12,499	11.8
$1,000,000-$1,999,999	6,304	4,614	36.6
$2,000,000 and over	3,298	2,704	22.0
Total	205,7	229,37	-10.3

Source: Statistics Canada, Census of Agriculture, 2006 and 2011

Table 3. Average gross farm receipts for younger operators, Canada 2010

Farm category	Average gross farm receipts ($)
Farms with all operators under 35 years	204,558
Farms with under-35 operators alongside older operators	450,485
Farms with all operators over 35	240,027
All farms	248,199

Source: Statistics Canada, Census of Agriculture, 2011

2.2. The succession effect

The Succession Effect2 relates to the phenomena whereby having an identified successor to the farm business prolongs the PDM's investment into the farm business. Potter and Lobley3 further contend that the Succession Effect can take place throughout the farm manager's career and is not reserved to the time at which a farmer is contemplating retirement. Therefore, the Succession Effect can greatly affect the way business decisions are made, leading up to business succession. In Figure 1 below, TFA represents Total Farm Assets.

The Succession Effect demonstrates the importance of raising awareness of farm transition and succession, and bridging the gap between the exiting generation of farmers and new entrants in terms of knowledge transfer – where enthusiasm meets experience.

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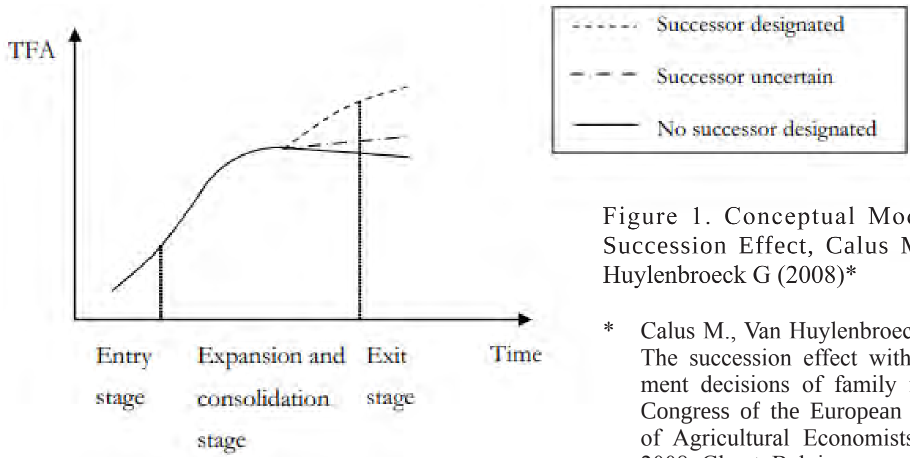

Figure 1. Conceptual Model of the Succession Effect, Calus M,and Van Huylenbroeck G (2008)*

* Calus M., Van Huylenbroeck G., 2008. The succession effect within management decisions of family farms. 12th Congress of the European Association of Agricultural Economists – EAAE; 2008; Ghent, Belgium.

3. STEP UP™ Mentorship Program – where enthusiasm meets experience

STEP UP™ is Canada's only national mentorship program that focuses on developing farm management skills across all regions, production sectors, farm size, and across Canada's official languages. Typically attracting young and beginning farmers, STEP UP™ also caters to those transitioning within the industry, to connect with and learn from leading farm managers.

STEP UP™ is an on-farm learning placement that matches those who are considering a farming career or transitioning to a new production sector with an experienced farm manager for a chance to learn farm business management skills in a hands-on setting. STEP UP™ also provides the experienced farmer with a fresh perspective on their business.

3.1. The Mentors – transferring knowledge

Mentors not only share their knowledge in farm business management and passion for the Canadian agricultural industry, but also inspire Mentees to follow their farming dreams.

Mentors are trainers, guides, teachers, and confidants – all rolled into one. People are often attracted to the role of a Mentor because they are interested in encouraging and inspiring growth, development and success in others. An ideal Mentor has expert knowledge of at least one area of farm business management, knows how to recognize the keys to success, is a good communicator, and has an open mind. Mentors often become lifelong friends with Mentees and the mentorship continues well after the completion of the STEP UP™ program.

3.2. Mentees – learning from the best

Mentees involved in the STEP UP™ program can expect to have a hands-on farm business management learning experience. Mentees receive mentorship from an expert in their topic of interest. Mentorship increases Mentee motivation and confidence while building a wide network of contacts. Being matched with an experienced farmer allows the Mentee to learn and develop new skills and abilities from someone who has applied knowledge and best practices.

Through FMC's partnership with the Canadian Young Farmers' Forum and Canada's Outstanding Young Farmers' Program specifically, FMC enjoys a large pool of distinct farmers from which to draw Mentors.

Mentees interested in receiving a Mentor's help must take the time to analyze their career path and identify what they expect from a Mentor. Mentees and Mentors strive to build an open, candid atmosphere that lends itself to discussing their concerns. They should be receptive to advice and suggestions, although Mentees must never abandon their own judgment, recognizing that a Mentor cannot make decisions for them regarding their farming future.

3.3. The Learning contract

The STEP UP™ Learning Contract is an agreement between the Mentee and Mentor that allows both parties to jointly determine the goals and objectives for the Mentorship experience. It allows Mentees to pinpoint very specific learning goals. STEP UP™ Mentees are not limited by a pre-set curriculum that may or may not address their learning needs. Before a mentorship may begin, farm business management learning goals are negotiated between the Mentor and Mentee, submitted to the STEP UP™ Program by the Mentee, and then tracked through participants' Progress Reports. Some examples of learning goals achieved as reported in Progress Reports include:

- Cost of production,
- Farm traceability and food safety measures,
- Field-worker coordination and team management,
- Purchasing decisions, investment issues, and long-term infrastructure planning,
- CSA (Community Supported Agriculture) planning and management,
- Canadian Organic Standards and the certification process,
- Import/Export regulations,
- Contingency planning and risk management,
- Customer relations/Customer service and education,
- Succession and estate planning,
- Time management, scheduling, and prioritization,
- Environmental and resource management.

Mentors and Mentees complete two Progress Reports throughout the duration of the program. The first report is due at the half-way point of the mentorship with the final report due at conclusion of the mentorship. Reporting can be done in a variety of formats, such as a 500-1000 word document, a 5-minute (minimum) YouTube presentation, or a 5 minute (minimum) PowerPoint presentation. Participants are encouraged to be creative and include pictures of their Mentorship experience.

Year-over-year, FMC has been overwhelmed with the quality and detail within the Mentorship Reports. The reports demonstrate the true value of the program, identifying practical, tangible, measurable positive outcomes.

3.4. The STEP UP™ Mentorship Matching Process

As STEP UP™ is a national program, Mentors and Mentees are accepted nation-wide. FMC supports inter-provincial travel in order for participants to gain new insights of farming in other areas of Canada. However, FMC also recognizes that mentorships in the local community are beneficial for ongoing relationships without geographical constraints. The program is flexible to cater to various Mentee needs and desires.

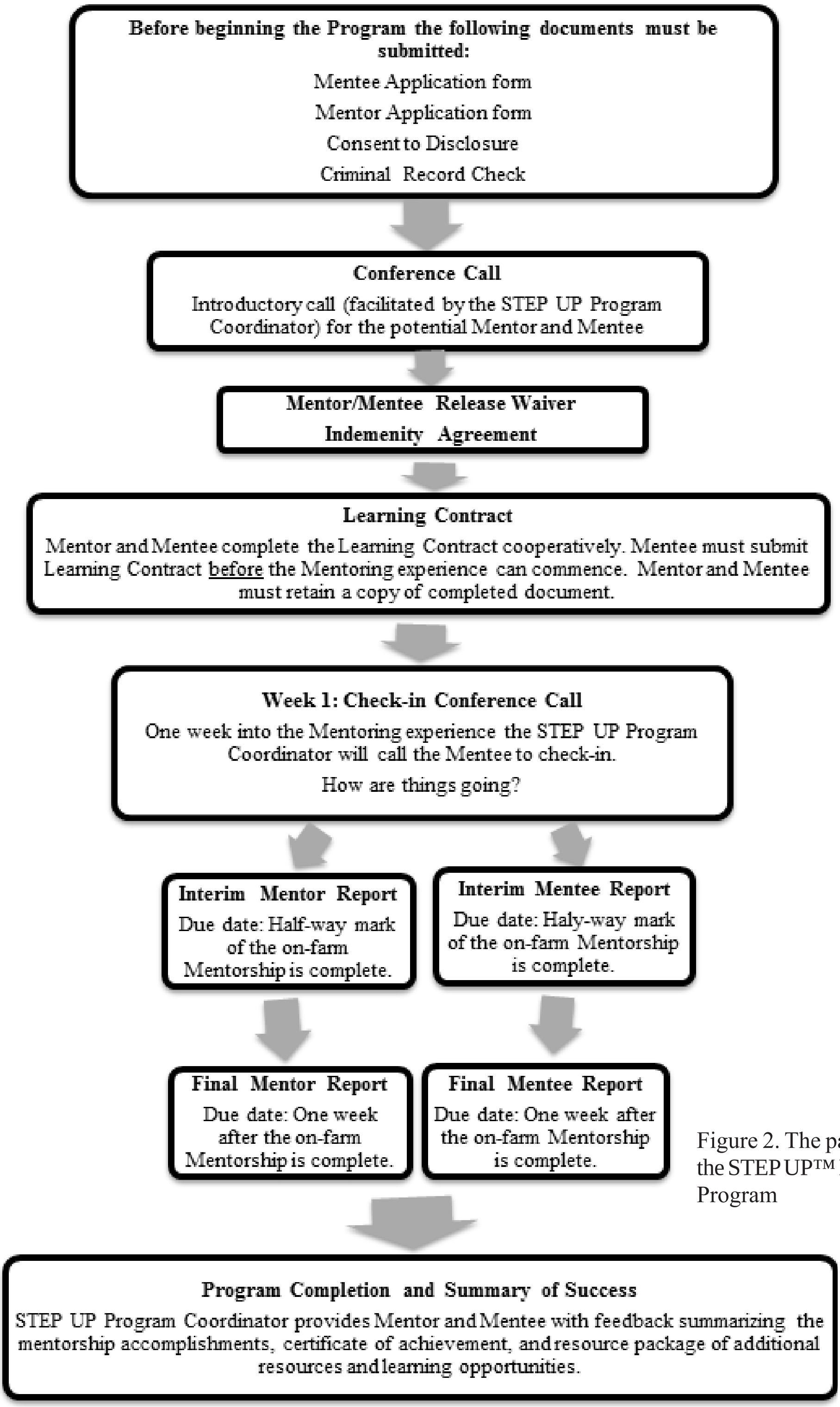

Figure 2. The path through the STEP UP™ Mentorship Program

STEP UP™ welcomes Mentors to the Mentor Roster at any time. Once a Mentor has submitted an application, FMC makes sure the eligibility criteria is met. A summary profile of their farming operation is then created and posted on the FMC website for potential Mentees to view. Mentors are not guaranteed to receive a Mentee.

During the winter season, FMC opens up the application process for Mentees and starts matching Mentees and Mentors according to the learning goals of Mentees and experiences and skills development offered by Mentors. Figure 2 outlines the path through the STEP UP™ Mentorship Program once a preliminary match has been made.

As seen in Figure 2, FMC maintains a connection to the Mentorship throughout the process, checking in with both Mentor and Mentee from time to time.

Mentees are required to stay a minimum of 8 weeks (total time) on the Mentor's farm, but many mentorships last six months or more.

Mentors and Mentees need to complete a Health Information Form and Release, Waiver, Indemnity Agreement before beginning the program. Salary, accommodations, and working/training conditions are negotiated between the Mentors and Mentees when completing the STEP UP™ Learning Contract.

Any wages are settled between the Mentor and Mentee; however Mentors are compensated with a $2,000 honorarium for participating in the STEP UP™ program, in recognition for the time they are taking out of their day to help teach the Mentee. Payment is made upon submission of each Progress Report.

To help establish the mentorship, FMC provides both Mentor and Mentee with a Mentorship Manual. The Mentorship Manual includes information on legalities including Labour Relations Standard booklet identifying the Minimum Employment Standards for all Canadian provinces and territories. It is important that each Mentor-Mentee relationship is informed of their rights and obligations.

At the end of the mentorship experience, FMC encourages Mentors and Mentees to revisit their Learning Contract, and submit a Final Progress Report.

Upon completion of the mentorship (at least 8 weeks total time), the Mentor and Mentee receive a Summary of Success recording their accomplishments. As well, the program partners provide a resource package to the Mentees to connect them to other additional resources and opportunities within the agricultural industry.

4. A model program

In 2012, FMC took part in the Canadian Agricultural Human Resource Council's On-Farm Work Experience Feasibility Study to inform best practices of leading on-farm learning programs.

The Study found that the STEP UP™ Program's self-directed learning design is ideally suited to facilitate the mentorship process since it recognizes farm managers as subject matter experts.

Not only are Mentees benefitting, but likewise, Mentors are gaining valuable new ideas and insights into their farm business from the fresh perspectives brought by the Mentee.

4.1. The STEP UP™ experience – what participants are saying

"*It has been a huge benefit to have a [Mentee] become immersed in and experience our farm…..to ask us questions….this allows us to critically analyze our choices... either reinforcing those decisions or causing us to make changes to our production practices.*" Mentor Kristian Vester of Blue Mountain Biodynamic Farms Ltd., Alberta.

"I appreciated that the STEP UP program asked us to set goals at the beginning in order to focus on some specific areas of interest. There are many things that I learned throughout my internship, but being able to refer back to set goals allowed me to crystalize the lessons and further understand my new experiences." Mentee Lindsay Fischer.

"Not only are my mentors teaching me a great deal, they are also becoming my friends and will any luck be in my life for many years to come!" Mentee Olivia Ronkainen.

"The STEP UP program has given me the confidence needed to manage a farm business of my own…Based on my experience, I hope to one day mentor aspiring farmers in the future. I am very grateful to have participated in the program, and will use the skills and knowledge I have developed to serve the agricultural community better." Mentee Arden Esqueda.

"*One of the biggest lessons I will take from this experience is to not underestimate the importance of solid business practices. You may have the best product/service in the world, but if no one knows about it…. or if you can't afford to produce it…then a successful business will remain out of your reach*." Mentee Evalisa McIllfaterick.

4.2. An evolution in programming: looking ahead

The STEP UP™ Mentorship program was established in 2007. In 2011, the program was restructured as a partnership between the Farm Management Canada and the Canadian 4-H Council, Canadian Young Farmers' Forum, and Canada's Outstanding Young Farmers' Program. Program partners have established a rich pool from which to draw Mentees and Mentors. Along with establishing a partnership network for recruitment and delivery, STEP UP™ also enhanced its programming with the Learning Contract, Mentorship Manual and a dedicated coordinator, along with marketing and promotional materials to increase awareness of the program and its accomplishments to help grow the initiative. The chart 4 shows the increasing popularity of the STEP UP™ program.

In 3 years, Mentee applications have increased by 64% while Mentor applications have increased by 73%. Currently, the only regions in Canada not represented by program applicants are Nunavut and the Northwest Territories. STEP UP™ will remain a small program with 20 Mentor-Mentee matches supported in 2013-2014. Applicants recognize that it is a privilege to participate in STEP UP™. STEP UP™ acts as a national umbrella linking work experience programs across the country, creating a mentorship network, and in effect strengthening the overall practice of mentorship and knowledge sharing in agriculture. At the same time, STEP UP™ is able to emphasize the importance of addressing agribusiness skills in mentorship experiences. In order to maximize the impact of the STEP UP™ program, efforts are being devoted to open the program to partnership coordination and delivery. This past year, STEP UP™ broadened its influence by developing a Youth STEP UP™ pilot project. The Youth program is similar in structure and design and addresses the learning needs of Mentees aged 15-17 years. This pilot project was a tremendous success and is now packaged and ready to be implemented by 4-H clubs across Canada.

Table 4. The popularity of the STEP UP™ program

The popularity	2013	2012	2011
# of Mentee Applicants	46	24	10
# of Mentors on Roster	58	32	9
# of Mentor-Mentee Matches	20	13	5
# of Completed Mentorships	N/A*	13	5

*2013 Program incomplete at time of submission

In addition to helping youth develop farm business management skills, opportunities have also been identified for language training, leadership development and other spin-off focuses while concentrating in business management topics.

Looking to the future, the STEP UP™ mentorship program will continue to collaborate with like-minded organizations in order to promote hands-on farm business management training. With the aim of retaining the quality and consistency of the mentorship program, the STEP UP™ Program Partners are interested in tracking a progressive and thoughtful course for program growth and development.

5. Conclusions

The STEP UP™ mentorship program bring business management skills development into a hands-on, practical setting, thusly responding to the learning preferences and practices of Canada's farmers.

The program's structured approach to learning helps participants achieve identified goals and keep their learning on track, ultimately changing behaviour at the farm level.

As Canada's aging farmers plan for their retirement, and new farmers get ready to take the reins, we can take comfort in knowing that the foundation for Canadian agricultural excellence will remain unshaken. By passing on experience and best practices, Canada's farmers are leaving their legacy to future generations, ensuring ongoing success and prosperity for Canadian agriculture and its farmers.

5.1. Farm Management Canada Funding

Farm Management Canada is funded in part by Agriculture & Agri-Food Canada under the Growing Forward program, a federal-provincial-territorial initiatives, and a growing number of partners. With this support, FMC is fulfilling a significant role in nurturing a thriving Canadian agriculture industry.

5.2. Farm Management Canada

Farm Management Canada, formerly the Canadian Farm Business Management Council, was established in 1992 to coordinate, develop and disseminate farm business management resources and tools to Canadian farmers. As a national umbrella for farm business management in Canada, Farm Management Canada (FMC) is the only organization dedicated to the coordination, development and delivery of business management information, resources and tools to position Canada's farmers for success. FMC connects the Canadian Agricultural industry and continues to build a culture of business management and best practices at the farm level.

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COMMUNITY LED RURAL DEVELOPMENT EUROPEAN UNION POLICY 2014-2020 POTENTIAL FOR PROGRESSION OR REGRESSION?

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Abstract

Community Led Local Development (CLLD) has been directly supported by the European Commission via the European Agriculture Fund for Rural Development (EAFRD) since 1991 through a mechanism called the 'LEADER Measure'. This approach has been particularly successful in Ireland with the evolution of community led Non Government Organisation's known as Local Action Groups across the state. These local development bodies have been recognised across Europe for their effectiveness, innovation and flexibility. They are deeply embedded and linked within their communities and have created a higher level of added-value to the LEADER funds than any equivalent structures in the EU. Over the past twenty one years Irish Local Action Groups have evolved to attract a broad range of funds (not just EAFRD) and shape these into an integrated suite of supports for entrepreneurs, target groups and communities. A new CLLD 'Multi-Fund' mechanism was agreed by the European Commission as part of the EU Structural Funds 2014-2020 which could see rural Local Action Groups accessing a range of EU funding opportunities and would be additional to the LEADER Measure of the EAFRD. The European Commission want to encourage Member States to adopt this approach and has introduced additional incentives to achieve this goal. Irish Local Action Groups, based on their experience and capacity to operate in this 'Multi-Fund' arena should at this time be perfectly placed to maximise these opportunities. However in parallel there are emerging complications and challenges. The adoption of the new Multi-Fund Approach to CLLD is 'optional' for Member States. Its inclusion as part of the delivery of the EU Structural Funds must be agreed and adopted in the coming months. There are indications that few if any Member States will make use of the CLLD Multi-Fund Mechanism. An additional complication has emerged in Ireland through a recently published 'National Policy', generated by the Department with Responsibility for Local Government and Community Funds, that suggests a new 'LAG Type Structure' within the Local Authorities may be allocated the responsibility to manage LEADER in the future. This paper will explore the background to these positions and will consider the potential impacts for rural communities. The authors would seek to promote a debate on the merits and challenges presented by the Multi-Fund Approach to CLLD through the forum of the IFMA 19 Congress, as these issues and related decisions will be taking place in Member States across the EU during the Summer-Autumn Period of 2013.

Keywords: rural development policy, LEADER, European Union

1. LEADER – leading the CLLD approach since 1991

Rural areas are by their nature more challenged in terms of their capacity to stimulate new forms of enterprise and in terms of providing basic services for their communities. Broad rural development support mechanisms tend to specifically focus on agriculture. Regional policies have had limited impacts on the relative competiveness of rural areas. In 1991, the then President of the European Parliament, Jacques De Lors, introduced a mechanism whereby a small percentage of the European Budget would be allocated to Community Led Local Development (CLLD) bodies in rural areas. The idea was to introduce a 'bottom-up, community led' approach to complement the efforts of the State in addressing the major challenge of achieving balanced rural sustainability. This was called the LEADER mechanism, approach or measure.

The basic principle of the LEADER approach is to provide resources to locally orientated and locally managed development bodies known as Local Action Groups (LAG's). These would determine how to invest these resources, based on their local knowledge of opportunities and challenges that exist within their areas. These LAG's are selected on their proven ability to encourage, develop and invest in enterprise, employment and quality of life initiatives in a manner that is innovative and effective. The levels of CLLD/LEADER investment received by the LAG is based on the strength of the vision of their Local Development Strategy (LDS) and the LAG's proven capacity to create 'added value', in terms of attracting additional local private, corporate and public funds to support the sustainable development of their area.

The LEADER Approach has grown and evolved from humble beginnings in 1991 as a five year 'pilot initiative'. At the time there were fewer than 200 LAG's selected and their total allocation was just over €100m. By 2013 2,300 LAG's existed across the EU. Between 2007 and 2013 these groups will allocate €5.5bn with an estimated additional 'leverage' of private and public funds of over €3bn for investment into the rural economies across the twenty seven member states of the EU. LEADER funds have actively created or diversified hundreds of thousands of jobs in rural areas during this difficult economic period and have invested in key community services, assisting the sustainability of local villages and market towns.

2. Ireland's evolution of the LEADER approach

The LEADER Approach is centred on the capacity of a local, community (civil society) led bodies to strategically focus on local needs and opportunities and plan and prioritise how to best enable and encourage the most effective and dynamic value added impacts with the resources available to the LAG. During the twenty one years of the LEADER Approach across Europe different 'models' have evolved.

In Ireland and in some other Member States the LEADER Approach is shaped on a 'Partnership' between the 'Lead' partner which are elected 'Community Leaders' who are the largest shareholder. They invite representation from Local Government, Social Partners (including Farming Bodies, Trade Unions and Employers) and State Bodies that are relevant to their Local Development Strategy.

Before the introduction of LEADER, communities, cooperatives and collectives across Ireland were voluntarily formed to address local economic and social issues through local 'integrated movements'. These bodies or 'movements' became the foundations of the Irish LAGs that were formed from 1991. With the introduction of LEADER these movements finally had a facilitator and investor in local enterprise and community development, based on their local vision. The work of the Irish LAG Structures is recognised by the European Commission and Parliament as one of the most successful since the introduction of the LEADER Approach. A key element to their success is the level of autonomy, linkage, and positioning that the LAG structure has developed within their communities as well as their capacities to attract investors, add value and account for public investments.

3. Irish LAGs – developing the compliance structures and systems

Funding through the LEADER Approach can only be managed by a 'legal entity'. In Ireland LAGs typically formed not-for-profit 'Private Limited Companies' with charitable status. Boards of Management were formed (with yearly elections and a one third rotation rule) who established internal audit and operations committees. The Board and all committee members are 'volunteers' who give their time without any payment. They hired staff to help shape and enact their Local Development Strategies, encourage project development and to develop the internal fiduciary systems to comply with EU and National public expenditure requirements.

Irish LAG's develop their Local Development Strategies and submit these plans (typically every six years) in a competitive bid for funds. The Plans are assessed and reviewed before a multi-annual (six or seven years) allocation is agreed for the LAG. This is usually undertaken by the Department of Agriculture who are the 'Managing Authority' of the LEADER Funds within the State. At the beginning of each multi-annual allocation the Department will issue guidelines and rules to the LAG's based on the European and National Rural Development Programme requirements. These include the broad terms of reference of the funding and general areas of ineligible or eligible project spend.

Throughout the lifetime of each funding allocation the LAG must formally report all expenditure on a monthly and quarterly basis with year-end progress reports. The Department also undertakes 'inspections' of files, projects and reports on a regular basis. The LAG must complete and file independently audited annual accounts and comply with best practice corporate governance, whilst also complying with state aid rules and public expenditure ceilings on salaries and expenses. Additionally, the LAG will be audited on average twice yearly by State-appointed auditors or funding bodies or periodically by the European Court of Auditors.

As a result of developing these capacities all project decisions are made by the Board of Management of the Irish LAG's. All contracts of grant aid are provided directly by the LAG to the project promoters and all payments of grants are issued by the LAG's. This level of intellectual capital has required a major investment of resources over the past twenty one years, not least of which is the time given by the hundreds of volunteers that are an essential component of the Irish LAG Model.

4. Irish LAGs – evolving beyond LEADER; the multi-fund approach

One of the other unique features of the Irish LAG's is the manner in which they utilised the LEADER Approach beyond the Rural Development Programme. The LEADER Funds allowed the LAG's to develop a unique 'platform or bridge' to attract public funds for dedicated investment and linking these with local and community needs and opportunities. In developing their Local Development Strategies Irish LAG's are also in a position to support communities to address key social inclusion challenges, gaps in key services for their communities (that cannot be met by the Rural Development Programme alone) and in particular creating opportunities for people who have become unemployed during the current economic crisis.

In many instances the LAG identifies an opportunity to attract additional funding to their areas that will meet needs in their Local Development Strategy that cannot be resourced from existing funds. The LAG will invest in the research, identify and bring together the key partners required and invest time in developing the 'Application' and related plans for these 'additional funds'. The proven capacity of the Irish LAG to plan, attract investment partners, 'animate' actions and development processes and account for LEADER/Rural Development Resources is central to their success in gaining the confidence of other providers of public funds.

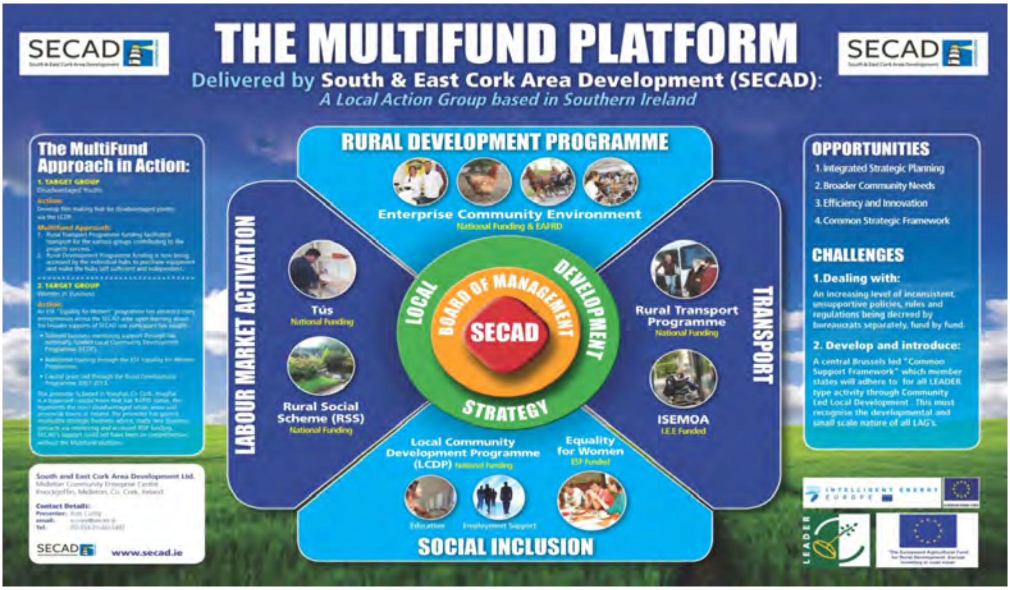


Illustration 1. SECAD's Multi-Fund Approach 2009-2014

The Illustration that follows shows the diversity and integration that one of the Irish LAG's, South & East Cork Area Development (SECAD) has achieved over the years. The 'anchor' investment to their overall Local Development Strategy is the LEADER /Rural Development Programme. This platform has enabled the LAG to host and manage six other multi-annual investments to support local Employment, Social Inclusion and Community Transport. This in turn broadens the levels of linkages with the local business and development community and creates the opportunity for the LAG to provide supports to a much wider audience. By integrating the investments within an overall local vision the Irish LAG's have initiated a process known as the Multi-Fund Approach.

5. The LEADER approach and EAFRD 2014-2020 *(Positive Features 1 & 2 for LEADER 2014+)*

The EAFRD Priorities for 2014-2020 include:

1. Horizontal priority: Fostering knowledge transfer and innovation,
2. Competitiveness of all types of agriculture and farm viability,
3. Food chain organisation and risk management,
4. Restoring, preserving and enhancing ecosystems,
5. Resource efficiency and transition to a low carbon and climate resilient economy,
6. Social Inclusion, poverty reduction and economic development.

The core funding to support the LEADER Approach will be allocated through the sixth priority of 'Social Inclusion, Poverty Reduction and Economic Development'. All EU Structural Funds require a degree of co-financing from the Member State. For countries like Ireland this is a major challenge. The requirement for the Rural Development Programme 2014-2020 will require the Irish State to match the EU Funds with circa 50% financed from the State. The LEADER Measure however will have a lower level of co-financing required; the State needing to put forward as low as 20% of the co-financing (*Positive Feature 1 for LEADER 2014+*).

There is also the opportunity for Member States to 'broaden' the definition of the actions to be underpinned by the LEADER approach. This will potentially allow the LEADER Measure to also include actions and resources allocated under any of the other five priorities of the EAFRD, where it is seen that the LEADER Approach can have a more effective impact. In doing so the Member State will have the opportunity to reduce the levels of co-financing required, thus making the LEADER Approach more attractive at this time (*Positive Feature 2 LEADER 2014+)*

6. Emerging CLLD multi-fund policy *(Positive Features 3 & 4 for LEADER 2014+)*

The use of the Community Led Local Development (CLLD) approach is now formally acknowledged as a powerful tool to enable sustainable and inclusive development in line with the Europe 2020 Strategy. In preparing the new round of EU Structural and Investment Funds 2014-2020 the European Commission and European Parliament are providing the opportunity to expand the use of the CLLD Approach to be applied not only to the EAFRD from 2014, but also (optional) to a range of other sources including the European Regional Development Funds (ERDF), European Social Funds (ESF) and European Fisheries Fund (EFF). This, in effect, is a platform to support access to a Multi-Fund support for CLLD.

The European Commission have developed an overall coordination guidance through their 'Common Strategic Framework' (see outline on Appendix 1) and are encouraging each Member State to adopt this integrated approach in the design and delivery of their 'Partnership Agreement' to be completed in the Summer-Autumn of 2013. The Partnership Agreement is the overall plan to be developed and agreed by each Member State, outlining their planned strategies and approaches in utilising EU Structural Funds to achieve their targets within the Europe 2020 Strategy. This will include a specific section on the CLLD Multi-Fund Approach to be allocated to LAG's, requiring an outline of how and where this approach may be considered and which funds will be used for this purpose. For Local Action Groups this could mean greater access to funds, a broader suite of supports offered to communities and a simplification of the administration in attracting, managing and reporting on expenditure (*Positive Feature 3 for LEADER 2014+*). The European Commission have allowed that the adoption of the CLLD Multi-Fund Approach is 'optional' for Member States (i.e. they can choose to include or exclude it from their Partnership Agreement). However, they have also 'incentivised' the adoption of the CLLD Multi-Fund Approach by including a reduction of 10% State Matching Funding for any elements of the ERDF, ESF and EFF that are included in this approach. They wish to enable the piloting of the approach in some Member States in the 2014-2020 as it is anticipated that such an integrated approach will become a central element of any EU budgeting framework beyond 2020. This should be a major incentive for economies that are under their own economic pressures at this time (*Positive Feature 4 for LEADER 2014+*).

7. CLLD and potential impacts of 'policy' – progression or regression?

The recent completion of the budget negotiations, as part of the EU Structural and Investment Package 2014-2020, would indicate that there is potential for a major reduction for Irish LAG's in terms of their core Rural Development – LEADER Priority – of the EAFRD. However, as highlighted earlier this should be offset somewhat by the additional 'attractive' bonus of having a lower national co-financing rate applied to overall 'LEADER' Measure. Additionally, as outlined in this paper, the Irish LAG's have been leading the development of the CLLD Multi-Fund Approach across Europe for decades and are perfectly positioned to attract additional funds through the new European Policy supporting the CLLD Approach. Such a scenario would underpin the continuation of critical investment into rural communities at this key time in the development of sustainable, inclusive and stable local economies.

However, there is a challenge. In the first instance it is suggested that many of the Member States, including Ireland, do not appear to be attracted to the possibility of including the CLLD Multi-Fund Approach as part of their Partnership Contract. There may be a resistance to change at National Levels as the CLLD approach requires a commitment to changing the way in which funds are controlled and distributed. The traditional model was that for each of the EU Investment Funds (ERDF, ESF, EAFRD and EFF) a single 'Lead Government Department or Ministry' would shape the Funding Programme separate from the other 'Lead Departments' for the other funds and would solely control the allocation and delivery models applied. The CLLD element of any Partnership Contract would require the 'sharing and coordination' of funds across these EU Investments between Government Departments and allow the LAG to be the central delivery agent for these CLLD Funds. This apparent resistance may be understandable but is equally questionable, if it results in local tax payers having to raise an increased contribution for essential supports that will be targeted directly into their communities.

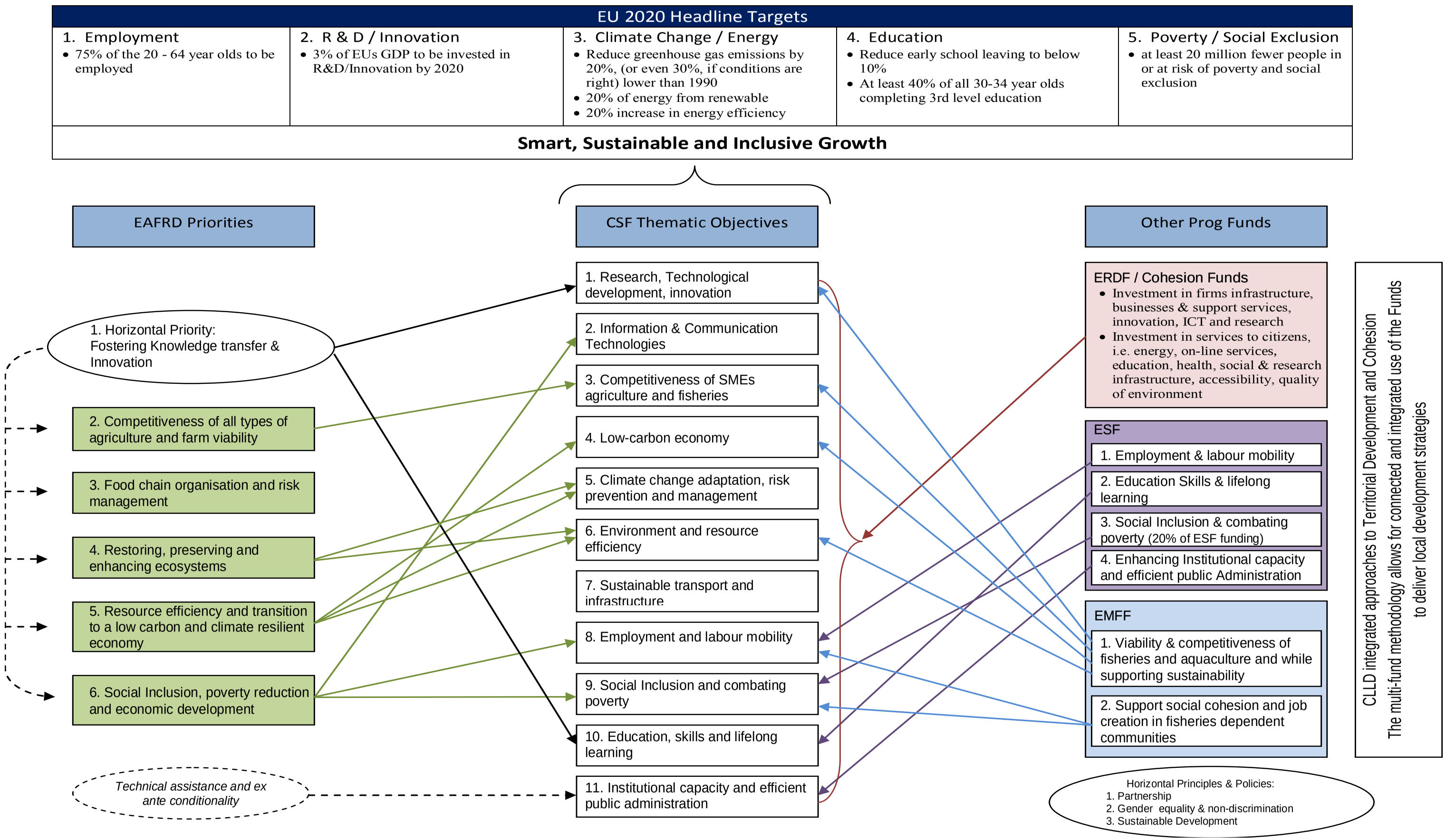
The decisions on the inclusion or exclusion of the CLLD Multi-Fund approach is being made in each Member State across the EU in the Summer-Autumn of 2013, yet there has been little or no public debate of note within the Member States themselves.

In Ireland there is the additional complication of a recently published 'National Policy', generated by the Department with Responsibility for Local Government and Community Funds that has indicated that it is possible that the LEADER Measure Funds in the future will no longer be planned, controlled or monitored by the LAG Structures that have evolved since 1991. It is suggested that the Irish Local Authorities could form and control a 'new LAG' called the Socio-Economic Committee which in turn would attract and retain the contracts for the LEADER Measure within the Rural Development Programme 2014-2020. The basis for this course of action is an effort to increase the effectiveness of Local Government in Ireland.

Irish CLLD LAGs, Social Partners and supporters of the Irish LEADER Model across Europe have asked for this 'Policy' to be reviewed and allow the existing LAG model to develop whilst providing greater oversight powers to Local Government. The existence of strong and effective Local Government in other parts of Europe has not diminished the need, potential or value of having a separate and strong CLLD delivery agent to shape and develop complementary supports and services. This view also reflects the findings of the most recent review of the LEADER Approach by the European Court of Auditors which strongly recommended the clear separation of function and roles between Local Government and CLLD Bodies. The Irish Government will be considering this policy in the coming months. Its decisions will determine the future of the Irish LAG's.

These decisions around the potential adoption of the CLLD Multi-Fund Approach and if it is to be 'Community Led' or 'Local Government Led' may ultimately also determine the fate of what the European Parliament has branded 'the most innovative and successful of all public instruments developed within any European Rural Development Investment Fund'.

Appendix 1.


EU 2020 Headline Targets
1. Employment
• 75% of the 20 - 64 year olds to be employed
2. R & D / Innovation
• 3% of EUs GDP to be invested in R&D/Innovation by 2020
3. Climate Change / Energy
• Reduce greenhouse gas emissions by 20%, (or even 30%, if conditions are right) lower than 1990
• 20% of energy from renewable
• 20% increase in energy efficiency
4. Education
• Reduce early school leaving to below 10%
• At least 40% of all 30-34 year olds completing 3rd level education
5. Poverty / Social Exclusion
• at least 20 million fewer people in or at risk of poverty and social exclusion
Smart, Sustainable and Inclusive Growth
EAFRD Priorities
1. Horizontal Priority: Fostering Knowledge transfer & Innovation
2. Competitiveness of all types of agriculture and farm viability
3. Food chain organisation and risk management
4. Restoring, preserving and enhancing ecosystems
5. Resource efficiency and transition to a low carbon and climate resilient economy
6. Social Inclusion, poverty reduction and economic development
Technical assistance and ex ante conditionality
CSF Thematic Objectives
1. Research, Technological development, innovation
2. Information & Communication Technologies
3. Competitiveness of SMEs agriculture and fisheries
4. Low-carbon economy
5. Climate change adaptation, risk prevention and management
6. Environment and resource efficiency
7. Sustainable transport and infrastructure
8. Employment and labour mobility
9. Social Inclusion and combating poverty
10. Education, skills and lifelong learning
11. Institutional capacity and efficient public administration
Other Prog Funds
ERDF / Cohesion Funds
• Investment in firms infrastructure, businesses & support services, innovation, ICT and research
• Investment in services to citizens, i.e. energy, on-line services, education, health, social & research infrastructure, accessibility, quality of environment
ESF
1. Employment & labour mobility
2. Education Skills & lifelong learning
3. Social Inclusion & combating poverty (20% of ESF funding)
4. Enhancing Institutional capacity and efficient public Administration
EMFF
1. Viability & competitiveness of fisheries and aquaculture and while supporting sustainability
2. Support social cohesion and job creation in fisheries dependent communities
Horizontal Principles & Policies:
1. Partnership
2. Gender equality & non-discrimination
3. Sustainable Development
CLLD integrated approaches to Territorial Development and Cohesion
The multi-fund methodology allows for connected and integrated use of the Funds
to deliver local development strategies

SUSTAINABILITY FOR A SUGARCANE GROWER IN THE SOUTH AFRICAN SUGAR INDUSTRY – CAN SUSFARMS® ADD VALUE?

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Abstract

A farm management system called SUSFARMS® was developed for growers in the South African sugar industry concentrating mainly on the sugar industry's best management practices but also taking the legislative requirements and sugar industry standards into account. Refinement of this tool in 2012 resulted in a revised approach, from linear to the full integration of the three principles of planet, people and prosperity. This paper will review the improvements and consider whether the sustainability of the South African sugarcane grower can be assisted by the implementation of SUSFARMS®. The paper will argue that although SUSFARMS® is a critical farm management tool that can be used to improve farm sustainability, the sustainability of the South African grower depends on a broader framework. Growers, however, play an integral role in the sugar value chain and therefore their adoption of SUSFARMS® would add value to all sugarcane products in the long term and their revenue in the short term. Although the Prosperity principle requirements have been enhanced in the 2012 version, further revision will be required and it is clear that adoption of this principle will provide a big challenge.

Keywords: planet, prosperity, people, sugarcane, SUSFARMS®, management
Sub-theme: environmental aspects of farming

1. Introduction

Sugar industries world-wide have become increasingly concerned about their own sustainability as many industries face declining margins between returns and cost of production, due to a long-term downward trend in the inflation adjusted price for sugar. This is a world-wide phenomenon and has resulted in competition for water, nutrients and other resources and consequently increased the risk of environmental impacts, such as degradation in soil health, climate change and atmospheric pollution. This has led to increasing scrutiny from regulatory agencies, community and consumer groups of the environmental sustainability of current sugarcane production systems (IFC, 2011).

The South African Sugar Industry is no exception to this position, revitalisation is critical to return the industry revenue to sustainable levels. In 2010 (SASA, 2010) a development plan was proposed for the industry which included the following elements:

- Appropriate regulatory environment,
- Harmonisation of SACU sugar sector policies to pave the way for SADC integration,
- Equity in access to preferential markets in EU,
- Regulatory environment in South Africa that allowed for participation in ethanol markets,
- Appropriate protection against low-priced imports of sugar,
- Comprehensive, co-ordinated approach to land reform and timely resolution of land claims.

Although varying degrees of progress has been made on most of these fronts, none of these have yet delivered any real change. Growers remain price takers mainly as a result of the industry regulatory environment and when combined with above inflation increases in input costs, it has resulted in many growers unable to achieve a return on their investment for a number of years.

Growers have responded by trying to improve their production efficiencies through improving yields or reducing costs, or a combination of both options.

When considering the above environment, it should come as no surprise therefore that the introduction of the Sustainable Sugarcane Farm Management System called SuSFarMS in 2007 was met with reluctance and suspicion by growers. Reluctance, as many growers saw SUSFARMS® as another "cost" to their business, and suspicion, as it looked like a way that local retailers would force producers to carry their "sustainability" cost and it could also be used as a barrier against third world sugar producers.

SUSFARMS® was developed mainly as a farm management system focusing largely on the sugar industry's best management practices (BMPs) but also taking the legislative requirements and sugar industry standards into account (Maher, 2007). SUSFARMS® (version 1) was refined through a rigorous stakeholder consultation process that included government, policy makers, NGOs and sugarcane producers (Maher, 2007; SUSFARMS®, 2008). It has recently undergone another major review resulting in SUSFARMS® version 2 (2012) in preparation of an industry roll out.

SUSFARMS® does not impose standards but works on the principle of continuous improvement through identifying areas of strengths and weaknesses, prioritising these, and implementing an action plan to address these, dependent on the financial status of the business (Maher, 2007).

This paper will argue that although SUSFARMS® is a critical farm management tool that can be used to improve farm sustainability, the sustainability of the South African grower depends on a broader framework. Growers, however, play an integral role in the sugar value chain and therefore their adoption of SUSFARMS® would add value to all sugarcane products in the long term and their revenue in the short term. Integration of the three principles in the 2012 version of SUSFARMS® will ensure that all aspects of the business are considered. Although the Prosperity principle requirements have been enhanced in the 2012 version, further revision will be required and it is clear that adoption of this principle will be a bigger challenge.

2. Methodology

Using the Good Management Practices Manual for the Cane Sugar Industry (IFC, 2011), a comparison will be undertaken of the initiatives that a number of sugarcane growing industries are implementing to address the issue of grower sustainability/economic viability and those of South Africa.

Business sustainability is important for all growers and the adequacy of SUSFARMS® to assist in this regard, particularly the prosperity principle, will be assessed. The 2008 and 2012 versions of SUSFARMS® prosperity principle and the three modules will be compared to determine whether the three modules adequately cover modern South African business requirements. The prosperity principle will be the focus of this analysis.

Six farms were audited focussing on SUSFARMS® BMPs (INR, 2011). The responses of these growers will be used as an indicator of grower sentiment to SUSFARMS® participation. More recently (Koopman, 2012) held a series of interactive workshops to identify the obstacles to grower participation in SUSFARMS® before the 2013 industry-wide roll out. These outcomes will be used to inform the future requirements for implementation.

3. Results and discussion

3.1. Assessing sustainability/economic viability in Brazil, Argentina, India, Swaziland and South Africa

The 'Good Management Practices Manual for the Cane Sugar Industry" (IFC, 2011) visited a number of sugarcane industries to identify measures used to achieve Economic Viability, Social Sustainability and Environmental Sustainability in these countries (Table 1). The last two columns provide the South African perspective which shows that although inertia exists at an industrial level, the move of the industry into a vertical slice structure (slices) may provide the required impetus to introduce sustainability/viability measures. The measures identified in the "slices" column resemble the results in the Brazil column. Many of the Brazilian measures are driven by the independent Millers and it is anticipated that the same will happen in the "slice" environment in South Africa.

Table 1. Measures identified to support economic viability of sugarcane growers in sugarcane growing countries

Economic Viability Measure	Category	Brazil	Argentina	India	Swaziland	South Africa	Slices
Strategic acquisition	Innovation	√		√			√
Partnerships	Structure	√				√	√
New Projects	Innovation	√					√
Data management and action plan	Knowledge	√			√		√
Optimising cane supply into mill	Optimisation	√					√
Optimising variety per mill (P&D)	Optimisation	√	√		√	√	X
Precision agriculture – fertilizer and herbicides	Optimisation	√			√		X
Investing in R & D to reduce input costs	Innovation	√					
Expanding sugar and ethanol markets	Markets	√			√		
Promotion of by-products	Markets	√			√		√
Partnership and supplier models	Structure	√					√
Utilization of all products by industry	Innovation	√					
Gravity powered irrigation systems /energy	Optimisation	√			√		X
Controlled traffic, min till and green manuring	Optimisation		√			√	X
Green cane trash blanket	Optimisation		√				X
Farm labour efficiencies	Optimisation		√		√		X
Intercropping and crop rotations	Optimisation			√			X
Effective use of farm infrastructure	Optimisation		√				X
Bargaining position of growers	Structure		√	√		√	
Small-scale grower models	Structure			√	√	√	
Farmer support model	Advisory			√		√	
ISO system	Structure				√	√	
Pest and Disease support service	Advisory				√	√	
Seedcane nursery schemes					√	√	

Because sugarcane growers world-wide operate in highly regulated socio-political environments, the broader framework of industry initiatives including institutional arrangements, new products and new markets, research and development and advisory support become fundamental to the survival of growers. Also not discussed here are the issues of supply and demand, government support mechanisms and low export market prices, all impacting on the price growers receive for their sugarcane (Maher, 2010).

3.2. Comparison of the two versions of SUSFARMS®

SUSFARMS® was designed to encourage sustainable sugarcane production through the implementation of better management practices (BMPs), which reduced the negative impacts of sugarcane agriculture on the environment.

3.3. SUSFARMS version 1 (2008)

The three fundamental principles embraced in both versions of SUSFARMS® include prosperity (economics), people (social) and planet (environment).

Each principle included a criterion/a in version 1 which added meaning to the principle but was not a direct measure of performance. A set of indicators and verifiers were developed for all the criteria in version 1 (2007). The indicator was the fundamental audit element and the degree to which a farm complied with the indicator was assessed by the verifier. The verifiers required compliance or non-compliance, from which corrective actions were identified for implementation. In principle, if the verifiers and indicators were met then the objectives of the criteria and principle would be satisfied leading to sustainability (Figure 1).

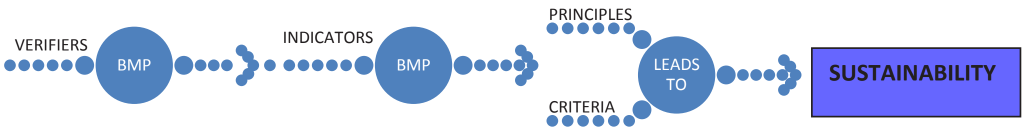

Figure 1. Linear Conceptual Framework of SUSFARMS (Maher 2007)

The way this worked is illustrated below using the prosperity principle, criterion, indicators and verifiers as an example.

3.4. Prosperity Principle

Economically viable sugarcane production is maintained or enhanced.

3.5. Criteria

The agronomic and mechanisation practices of the sugarcane farm are integrated with the climate, soils, water and topography to obtain an optimum and sustained economic crop production.

3.6. Three key indicators

- **The Land Use Plan.** This is the foundation of SUSFARMS® and is a critical visual planning tool.
- **The Annual Production Plan.** The production potential of the land is maintained or enhanced through recording and monitoring inputs. The measures require a good up-to-date record-keeping system to capture area planted, variety planted, yields, replant information, type of inputs applied and quantities eg fertiliser and herbicides and infrastructure development and maintenance.
- **The Annual Financial Plan.** This was linked to farm budgets and costing's.

3.7. Verifiers

Details and specifications were listed. The emphasis in this version is mainly on the land use plan, production plan and lastly, the financial plan. Given that SUSFARMS® was designed by the sugar industry Sugarcane Research Institute (SASRI) extension service, it is not surprising that the land use and production plans were considered important tools for managing sugarcane cultivation in a sustainable manner (Maher, 2007). The financial plan module does not address legislative nor accounting requirements and it duplicates much of the two other module requirements.

The industry advisory service is divided into two components with agronomic advice provided by the SASRI and the economic advice by CANEGROWERS. Neither group provides financial advice. Implementation of SUSFARMS® took place through SASRI and it is not surprising therefore that the land use and production plans were promoted at the expense of the financial plan.

3.8. SUSFARMS – version 2 (2012)

In version 2 (2012), the conceptual framework has been changed from a linear to an integrated relationship (Figure 2). This approach is similar to that of the World Economic Forum presented at IFMA 2011, where the goals of prosperity, people and planet do not have to be divorced and in its new vision for agriculture its key goals are to "provide food security for all, in an environmentally sustainable way, while generating economic growth and opportunity".

The new version has moved away from criteria, indicators and verifiers but has categorized the overall objective for the principle as a "statement of intent" with "measures" as auditable elements. The weakness of the Prosperity /financial plan has also been addressed. In addition a useful tool, the Progress Tracker" has been included to measure progress against a better management practice (BMP) or requirement (usually regulatory).

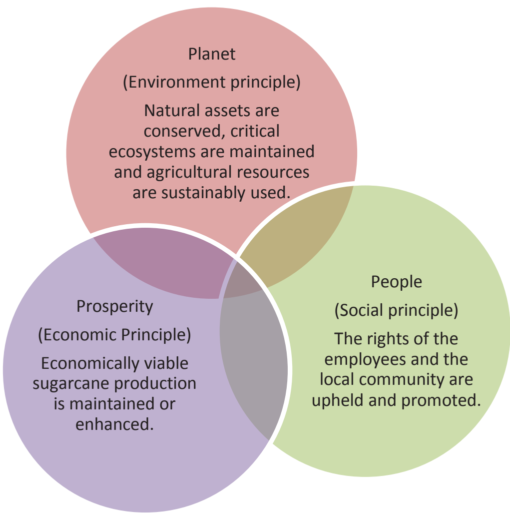

Figure 2. Integrated Conceptual Framework in SUSFARMS® (2012)

Once again, the Prosperity Principle is used as an example of the way this would work.

Prosperity Principle: Economically viable sugarcane production is maintained or enhanced.

"Statement of Intent": The agronomic and mechanisation practices of the sugarcane farm are integrated with the climate, soils, water and topography to obtain an optimum and sustained economic crop production.

In version 2, the three indicators become three modules supporting the Prosperity Principle:

- The Land Use Plan remains the same.
- The Annual Production Plan remains the same but is linked to the financial plan.
- The Financial Plan is considerably updated.

The annual financial plan requires that a farm budget and cash flow analysis be drawn up for the farm on an annual basis, this would include the production and mechanisation plans. There is a requirement for accurate record keeping, monthly account management and compliance with legislation:

- Annual Budget is drawn up.
- Monthly account management undertaken.
- Annual Financial Statements drawn up and audited where required.
- Financial tools are used annually to review the health of the business.
- Full understanding of the obligations of a business owner.

Annual financial planning relies on accurate record-keeping as per the Annual Production Plan and those aspects are identified below:

- A budget for income and expenses should be drawn up as per the production plan as well as other monthly expenses such as living costs, finance costs, insurance and also asset replacement, taxes, bonds and hire purchase.
- Cash flow and savings projections should be drawn up annually.
- All transactions associated with the farming activities must be captured on a monthly basis and monthly reports generated.
- Monthly account management should be undertaken which reviews the budget and cash flow and forecasts for the following months in order to take action when required.
- Annual Financial Statements should be prepared by an Accountant and these should be audited for specific entities.
- An annual review of the profitability of the business can be undertaken by CANEGROWERS using suitable financial indicators.
- The second version reflects integration of the three principles and also has addressed the weaknesses that were identified in the Prosperity section of version 1.

CANEGROWERS participated in this process to ensure that financial and production activities were not segregated. Service provision would need to be undertaken in an integrated way to avoid the bias towards BMPs (Maher, 2007) rather than integration of all three principles.

Further investigation into the prosperity principle was undertaken by SASA (2012) to determine whether the industry and growers would be able to comply with this principle. The results showed the following:

- Land Use plans and farm maps are either non-existent or outdated.
- Yield comparisons are not done on a field basis and variety information is sometimes collected on a field basis but age of crop is not.
- Book-keeping is often of a poor quality and accountants do not check the monthly book keeping. This is a risk to growers in terms of meeting their financial compliance.
- Monthly monitoring, cash flow reviews and forecasting are not undertaken regularly.

- Many growers and their book keepers are not aware of their compliance requirements and responsibilities as business owners
- Compliance with financial legislation eg Income Tax No.58 of 1962, Companies Act No.71 of 2008 and Value Added Tax Act No.89 of 1991 is not specified.

3.9. Growers' opinions on the benefit of SUSFARMS®

Although the opinions of six growers who participated in a cost benefit analysis of SUSFARMS® (INR, 2011) does not necessarily represent all growers, it does highlight that growers think that SUSFARMS® is all about farming better, the planet principle, rather than considering all three principles equally.

Grower 1 acknowledged that 'long-term agronomic benefits would be realised, but that the degree of compliance with BMPs was not being recorded and that the benefits referred to anecdotally above were not being monitored".

Grower 2 noted that the "application of soil conservation BMPs … reducing long term input costs and the likelihood of damage from severe storm events".

Grower 3 pointed out that cash-flow and funds to invest in SUSFARMS® BMPs are an important consideration for many growers. Farmers are more likely to invest in areas where short term results would be achieved, such as planting newer more productive cane varieties.

Grower 4 suggested that "a lot of the management practices contained in SUSFARMS® have to do with common management logic".

Grower 5 said that the pressure to produce sugarcane constantly is intense. "Cash flow requirements and production cycles do not favour fallow periods with green manure crops due to short term negative effects on cash flow, although the grower has noted yield responses directly after green manure cropping. In addition, the less noticeable, but critically important long term sustained yield benefits are not enjoyed in the short term and long term sustainable farming cannot be achieved without a proper LUP."

Grower 6 acknowledged that while the implementation of BMPs is management intensive and time consuming, they do provide the opportunity for guidance and continuous improvement.

3.10. Barriers to adoption

More recently an analysis of the barriers to adoption of SUSFARMS® was undertaken (Koopman, 2012) and showed that the key issues which hinder sustainability learning and practice were:

- There is weak participation from growers in formal learning opportunities.
- The lack of quantifiable evidence hinders grower and extension support.
- Strategic leadership from industry governance structures is not evident to people on the ground.

4. Concluding comments

The margins between production costs and the financial returns that growers receive and in more recent times the margins of profit, have been extremely tight. The profitability of growers is determined by a number of economic factors e.g. the sugarcane price, interest rates and the cost of essential inputs such as fertilizer, herbicides, and labour however the level of managing these inputs and resources in achieving attainable yields is a major factor that influences the viability of sugarcane farming. The price growers are paid for sugar is not adequate but this needs to be addressed within a broader industrial framework as is demonstrated in Brazil. SUSFARMS® can add value in this area only if the market were to pay more for "sustainable" sugar.

In this low income environment it becomes very difficult to "sell" SUSFARMS® especially in terms of cost benefits. Action research needs to be strengthened to quantify evidence of the cost-benefit risks associated with SUSFARMS® and implementing holistic on-farm sustainability practices. Based on observations during the INR (2011) study, it appeared that a growers' long term approach to farming and environmental ethic largely determines the degree of adoption of SUSFARMS® BMPs that focus on environmental outcomes. This means that to facilitate the wider adoption of these BMPs, incentives or real evidence of reward will be necessary. Although, when individual grower yields, cane quality and revenue on a homogeneous ward basis, within one ward, are compared, there are still growers that continue to grow sugarcane at a profit, some with and others without the implementation of SUSFARMS®.

A number of weaknesses exist in the support for SUSFARMS® in the industry. If a land use plan is a key requirement for successful farm planning and many growers do not have a plan, then the industry must provide this service to ensure the integrity of SUSFARMS®. The same applies to the financial plan module where an integrated grower support service would advise on all three principles of SUSFARMS® thus ensuring that growers view their business in a fully integrated manner.

It is recommended that a fourth module be included to elaborate on and highlight the importance of financial compliance and that an easy record-keeping tools be developed for the next version.

Until this happens the Prosperity principle will not be implemented in its entirety preventing growers from adding value to their own operations in the long term and many growers will remain suspicious and reluctant to embrace SUSFARMS® holistically.

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CLIMATE ADAPTATION RESEARCH PROPOSAL: EVALUATION OF DROUGHT TOLERANT SWEET POTATO VARIETIES IN NEW IRELAND PROVINCE, PAPUA NEW GUINEA

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Abstract

This paper discusses a proposal for research to evaluate for drought tolerant sweet potato varieties. This work is being carried out in light of the imminent drought. The experiment will be carried out under controlled conditions in the green house. Plants will be planted in wooden boxes (150 cm x 80 cm x 20 cm). Plants will be watered up to the 10th day after planting; and then watering will completely stopped; the trial is scheduled to take 75 days. The experiment will be repeated three times over a 12 month period. A randomized complete block design with 4 replicates will be used, where eight first class varieties recommended by the National Agriculture Research Institute (NARI) will be tested. Data will be collected on (i) plant wilt, vine length, vine diameter, number of branches, number of internode, leaf growth, leaf width and dry matter production. Data will be collected on 3 dates: 20 DAP, 40 DAP and 60 DAP. Analysis of variance will be used to statistically analyze data and mean separation using Duncan's Multiple Range Test.

Keywords: drought tolerant, sweet potato, evaluation, adaptation

1. Introduction

The effects of the 1997 drought in PNG are still rippling in the rural communities. The lessons learnt clearly showed that there was a general lack of preparedness in food security then as it is today. Increased efforts were subsequently focused on this concern however; there is more the community can do. Climate change adaptation is especially important in PNG since the memories and effects of the 1997 drought are vivid and still being felt 26 years on. PNG bore the brunt of the effects of climate change.

It was obvious that communities, districts and provinces displayed varying capacities to adapt. The pattern displayed was uneven across different communities however all had very little capacity to adapt and subsequently relied heavily on government relief efforts. The adaptive capacity was observed to be closely linked to social and economic development.

As the magnitude and the rate of climate change grows so does the adaptation challenge. A theoretical, physiological limit to adaptation is that humans cannot survive temperatures greater than 35^{o}C.

The overall goal of the project is to ensure food security during seasons of adverse climatic conditions (drought) through: (i) the selection of drought tolerant sweet potato varieties, (ii) multiplication of drought tolerant and (iii) germplasm maintenance.

It is generally accepted that sweet potato was introduced into Papua New Guinea some 400 years ago following European exploration into the New World. It has been proposed by Yen (1974) that sweet potato reached Papua New Guinea via Indonesia, India and Africa from the West Indies. Sweet potato is the major food crop in the highlands of Papua New Guinea and is replacing other staples in the lowlands. Papua New Guinea is considered the second largest center of genetic diversity in the world. Yen (1974) estimated that 5,000 varieties are grown in PNG, of which 1,600 are actually maintained in ex-situ.

In Papua New Guinea sweet potato (*Ipomoea batatas (L.) Lam*), or *kaukau* as it is known locally is an important root crop staple, especially in the highlands. From the sea level to 2700 masl, sweet potato is grown. Bourke (2006) reported that food energy supply from sweet potato has increased from 45% in 1961 to 65% in 2000. It provides the primary source of dietary energy for 60% of the population in the country (Bourke and Vlassak, 2004).

Sweet potato is an important source of carbohydrates and income in rural areas. It is produced under rain-fed conditions. Despite its importance, the yield is still very low for small scale farmers. Factors contributing to low yields are: drought stress, pests and diseases, the use of traditional varieties and low soil fertility. Sweet potato is the most important staple in Papua New Guinea. It is generally accepted that sweet potato was introduced some 400 years ago. Since its introduction it has gained prominence in the highlands, supplying 60-90% of the energy needs of highlanders (Kesavan, 1992). Sweet potato is also replacing traditional staples such as *Colocasia* taro in the lowlands due to its superior adaptability. Diseases (taro leaf blight) and insect pests (taro beetle) are the cause of the decline in taro production in the lowlands.

Estimations (Bourke, 2005b) of sweet potato production in PNG probably had a retail value of K1790 million ($450 million). As a starch, sweet potato has major economic advantages over rice as it is grown locally. PNG imports over 200,000 tonnes of rice annually, to the tune of K300 million. Sweet potato has the potential to replace rice and wheat flour as people do not view these food superior to sweet potato, taro and banana.

Food security issues highlight the importance of addressing yield decline issues as land use intensifies and climate change occurs. The advent of new technologies and research to address major yield limiting factors is imperative to ensure adequate supply of this staple.

Estimates by Bourke (1985) and Yen (1974) estimated that 5,000 varieties are grown in PNG, of which 1,600 are actually maintained in ex-situ. The National Agriculture Research Institute maintains sweet potato germplasms at its research stations at Aiyura (1231 varieties-Highlands Program) and Kerevat (1200 varieties-Lowlands Program)

Bourke (1982) and Kesavan (1992) have reviewed food crop research for a fifty year period, from 1928 to 1978. A total of 1230 trials on 77 crop species were carried out during this period. Of the 1230 trials, 693 (56%) were variety trials identifying superior planting materials. The work traditional staples logically concentrated on sweet potato which accounted for 11% of the research trials.

There has been a major investment into the evaluation of sweet potato through financial assistance from the European Union PRAP Project from 1990-1998. The PRAP Project evaluated about 1200 varieties. A total of 72 first class varieties were selected and currently are being multiplied for distribution. Work by Wijmeersch, Guaf, and Tep (2002) further recommended 8 sweet potato varieties as “first class recommendations”. These first class recommendations will be tested in the proposed experiment. NARI can also supply plant pathogen tested varieties.

The benefits from this project are numerous for example, local communities will have access to new and a larger selection of sweet potato varieties that are tolerant to adverse climatic conditions. Food shortages during these adverse climatic periods will be avoided and hence food security guaranteed. With food security secured, loss of life from food shortages and suicides will be avoided. Communities will also be free from mental and physical stress which would otherwise be the hallmark of such conditions. Furthermore the communities will not be dissatisfied with government regarding drought response as was the case experienced in the 1997 drought. Communities will be more prepared and will not depend as much on the government's assistance.

Drought reduces the quality of life which often will lead to changes in life style, however; if the communities are prepared in terms of drought response mitigation then quality of life will be maintained. The urban drift will also be avoided as rural communities will not migrate to urban areas seeking refuge as experienced in the 1997 drought.

2. Materials and method

The study site is located in the Tigak speaking area of New Ireland Province of Papua New Guinea. Kavieng, the capital of New Ireland province is also the biggest town on the island of the same name. Annual mean maximum temperature is 30.2^{o}C and an annual mean minimum temperature of 22.5^{o}C and an annual rainfall of 3183 mm. Kavieng is the main port for New Ireland, and is both a trading and tourist destination. Several dive companies operate from the town, as the area is known for its diving, both for natural sites and wrecks dating from the Second World War. There are plane and shipwrecks in Kavieng Harbour itself, as well as several more nearby.

The experiment will use eight sweet potato varieties (1st Class Recommendations) to be obtained from the Kerevat Research Station (NARI) where a germplasm is currently being maintained. The varieties to be evaluated include the following: L9, L16, L43, L46, L135, (PNG lowland varieties) and TIS 2498 and TIS 3017 (IITA). These will then be tested under controlled conditions (green house) in Kavieng, New Ireland Province.

Sweet potato cuttings of 30 cm in length will be planted in wooden boxes (150 cm x 80 cm x 20 cm). Plastic sheets will be placed within the boxes to prevent leaching. Soils derived from calcareous parent material will be used in the wooden boxes. The soils will be characterized, described and analyzed.

Application off water will be up to field capacity. Soil field capacities will be determined for individual boxes. Plants will be watered up to the 10th day after planting; and then watering will completely stopped; the trial is scheduled to take 75 days. The experiment will be repeated three times over the year. The implementation schedule is detailed in Table 1.

The project will cost K20,000 of which K15,000 will be sought from the government or other donors whilst K5,000 will be our equity contribution (Table 2).

Table 1. Implementation Schedule

Activity	1	2	3	4	5	6	7	8	9	10	11	12
Setting Office												
Supply of Sweet Potato varieties												
Soil Characterization, Description & Analysis												
Setting of Experiment												
Planting												
Observations, Data Collection & Reporting												

Table 2. Project Cash Flow

Month	1	2	3	4	5	6	7	8	9	10	11	12
Opening Balance	0	7700	6900	6600	5900	3900	3600	2900	1100	800	200	100
Sources of Income												
Equity	5000											
Funding Assistance	15000											
Total Income	20000	7700	6900	6600	5900	3900	3600	2900	1100	800	200	100
Operating Income	20000	7700	6900	6600	5900	3900	3600	2900	1100	800	200	100
Operating Cost												
Laptop & Printer	3500											
Stationaries	500											
Supply of Sweet Potato varieties	2000											
Shipping costs	1000											
Soil Characterization, Description & Analysis	1000											
Renovation of green house	3000											
Building of boxes	1200				1200			1000				
Planting of experiment		500			500			500				
Observations, Data Collection & Reporting		200	200	600	200	200	600	200	200	500		
Wages	100	100	100	100	100	100	100	100	100	100	100	100
Total Operating Cost	12300	800	300	700	2000	300	700	1800	300	600	100	100
Gross Surplus	7700	6900	6600	5900	3900	3600	2900	1100	800	200	100	0

A randomized complete block design with 4 replicates will be used, where eight first class varieties recommended by the National Agriculture Research Institute (NARI) will be tested.

Data will be collected will on (i) plant wilt (scoring visual appearance using a scale: 1-very wilted, 2-wilted, 3-little wilting and 4-No wilting), vine length, vine diameter, number of branches, number of internode, leaf growth, leaf width and dry matter production. Incidences of pests and diseases will also be collected. Data will be collected on 3 dates: 20 DAP, 40 DAP and 60 DAP.

Analysis of variance (Table 3) will be used to statistically analyze data and mean separation using Duncan's Multiple Range Test.

Biplot can also be carried out using statistical packages (SAS, Genstat, Minitab).

Table 3. Skeletal ANOVA

ANOVA	
Source of Variation	Degrees of freedom
Total	31
Reps	3
Varieties	7
Error (Reps x Varieties)	21

3. Results and discussion

Upon the analysis of data, drought tolerant sweet potato varieties will be identified suitable for our environment. The experiment will be repeated three times to confirm initial results. The promising varieties will then be multiplied for distribution to farmers. Information obtained from the study will be published as well as translated for farmers. Multiplication and distribution of drought tolerant sweet potato varieties would follow on after the completion of the experiment.

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AGTRANSITIONS: DEVELOPING A FARM BUSINESS TRANSITION PLAN

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Abstract

The average age of U.S. farmers and ranchers is over 57 years old. Nearly 30 percent of U.S. producers are over 65 years old. This means that more than 650,000 U.S. producers need to make decisions about the future of their farm business in the next few years. This paper discusses on online tool, AgTranstions, designed to help producers develop a plan to transition their business to the next generation. The demand for transition planning has been increasing rapidly. Many educators state it is the topic most frequently requested in surveys about training needs. AgTransitions does not replace the need for transition planning workshops or advisors, rather it provides a tool to help agricultural professionals work more effectively with producers who want to develop a farm transition plan. Agricultural producers who know they should develop a transition plan often do not know where to start. AgTransitions provides a detailed outline that helps producers improve communication and work through all of the aspects of developing a thorough plan. Sections include gathering all of the pertinent information, sharing the vision and goals of both generations, determining how and when to transfer management, ownership, income, and labor, developing a retirement plan and preparing information to meet with an attorney to develop an estate plan. In addition to the comprehensive outline, AgTransitions provides tips or suggestions for each section of the plan, resource links to articles on specific topics, worksheets and a sample plan. An innovative feature of AgTransitions is a producer's ability to give reviewers or advisors access to their plan and to interact with trusted reviewers as the plan is developed. AgTransitions, www.agtransitions.umn.edu, *is free for anyone to use and is online, so it is available and being used by producers throughout the world.*

Keywords: Farm Transition Planning, producers, U.S.

1. Introduction

The average age of American farmers and ranchers is over 57 years old. Nearly 30 percent of U.S. producers are over 65 years old. This means that more than 650,000 U.S. producers need to make decisions about the future of their farm business in the next few years. Some of these producers have developed transition plans and many of them are part-time producers who do not need a comprehensive transition plan. However, there are hundreds of thousands of producers who have not prepared adequately for the transition of their business to the next generation.

The demand for transition planning has been increasing rapidly. Many educators state it is the topic most frequently requested in surveys about training needs. As a result, there has been increasing attention devoted to farm transition educational programs in recent years. Workshops on this topic are usually very well attended. But transition planning takes time. Plans are usually developed over several months or years and require considerable interaction between family members. They also may need ongoing interaction with an agricultural professional. Usually an educator or consultant can help a family get started, but they rarely have the time for intensive ongoing interaction with the family as they work on their plan.

AgTransitions was developed by a team of farm transitions experts from across the U.S. to help producers have a framework with which to develop a comprehensive farm transition plan and to facilitate constructive communication between all of the family members involved. Over the past several years, it has proven to be a valuable tool for both farm families and the educators or consultants who assist them.

Sometimes transition planning takes a different form as farm families that have no family members who want to engage in farming as an occupation, seek alternative methods of transitioning their farm to a younger person who wants to farm. Some of these older producers actively seek to connect with the growing number of young people interested in beginning to farm. AgTransitions can also provide a framework around which to explore transitioning a farm business to non-family members.

2. Challenges in developing a transition plan

Many producers know they should develop a farm transition plan, but find actually developing one challenging. In part the challenges are due to not knowing how to proceed with the development of a plan, but they also face the challenge of addressing all the different factors that are involved with developing a plan.

The primary challenge faced by most families is simply open and honest communication. They need to get to the point where they understand each generation's goals and desires. Not only do they need to understand the goals of the family members who are involved in the farm business, but often there are family members who will not be involved in the future of the business, whose interests must also be considered. Communication between two or three generations within the family and between on-farm and off-farm heirs can be complicated and very challenging.

Identifying goals can also be challenging. Often family members have not clearly thought through their own goals and expectations, adding to the challenge of trying to communicate goals and vision to others. Once individual goals are identified, the next challenge is reconciling differing or even competing goals among family members. The goals of the successor generation may be quite different from the goals of the owner generation. The goals of the non-farm siblings may also vary considerably from the goals of those operating the farm business.

In addition to these broad, general challenges, families who engage in the process of developing a transition plan encounter numerous other topics that they must address. These include developing an estate plan to distribute the business assets and a tax plan to minimize the tax impacts of transferring the assets. The owners should develop a retirement plan that helps them determine when they will retire, where they will retire and what they will do in retirement, both in terms of future involvement in the farm business and other activities they may want to engage in once they have more time available. There are legal issues that must addressed including developing wills and trusts, how assets will be titled, and when and how assets will be transferred. Long-term care options should be discussed. Part of the plan should include how and when transfer of not only assets occurs but also a plan to transfer income, labor, and management.

Due to the complexity and challenges of developing a farm transition plan, most farm families find that working with an educator or consultant or participating in a transition planning workshop helps them make progress in the development of their plan. The help of a good educator or consultant can make the process much easier, but even with that help, developing a transition plan is a daunting task for most farm families.

The AgTransitions website was developed by a team of experienced farm transition experts from across the U.S. in cooperation with the Center for Farm Financial Management at the University of Minnesota to help make the process a bit less overwhelming for farm families. During the past three years, more than 750 producers have used AgTransitions to help develop a transition plan.

Numerous articles have been written on developing a transition plan and many workshops are delivered on this topic every year. AgTransitions was developed to complement, not replace these resources. Workshops and consultants are very important in the transition planning process, AgTransitions just provides a tool to help farm families understand the entire process and work through the development of their plan in a more organized manner.

3. AgTransitions, a tool to help develop a farm transition plan

The Center for Farm Financial Management (CFFM) at the University of Minnesota formed a national team to work on the development of an online agricultural farm transition planning tool. The team represented transition planning educators from different region of the U.S. including John Baker, Beginning Farmer Center, Iowa State University and chair of the International Farm Transition Network; Dave Goeller, University of Nebraska; Marsha Goetting, Montana State University; Gary Hachfeld, University of Minnesota; Jeff Johnson, Texas Tech University; Steve Richards, Casa Larga Vineyards, New York; Mike Sciabarrasi, University of New Hampshire; and Jeff Tranel, Colorado State University.

The result of this development team effort was AgTransitions, a powerful online transition planning tool. AgTransitions is free for anyone to use and is online, so it is available and being used by producers throughout the world. To use AgTransitions, simply go to www.agtransitions.umn.edu and register to setup a free account.

AgTransitions is built on the same platform used to develop AgPlan, an agricultural business planning tool. It has many of the same features as AgPlan, which has proven to be a very popular and useful tool. More than 19,000 producers have used AgPlan over the past few years.

4. Using AgTransitions

Once an account has been created, an outline for a transition plan is displayed. In addition to the plan outline, AgTransitions also provides tips or suggestions on what to include in each section of the plan, and resources which are links to articles about the specific sections of the plan, worksheets, and sample plans.

AgTransitions is designed to help producers develop a transition plan with assistance from agricultural professionals, so it provides the unique ability to interact whenever necessary with one or more advisors, educators, or consultants.

Developing a farm transition plan can be accomplished in few months, but usually takes much longer, often taking several years to complete. AgTransitions help families document and track their progress as they develop their unique transition plan. It also allows all involved parties full access to documents and to decisions as they are made.

5. AgTransitions outline

AgTransitions provides a comprehensive outline to help farm families consider all the aspects of developing a farm transition plan. The major sections in AgTranstions include:

- Getting Started,
- Your Information,
- Vision and Goals,
- Business Transfer Plan,
- Retirement Plan,
- Estate Plan Preparation.

Each section of the outline has a short video explaining why the section is important in a transition plan and how to get started on that section of the plan. There are a number of subsections under each major section of the plan. For example, subsections under Your Information include, owner generation, successors, nonfarm heirs, other parties involved, business description, assets, liabilities, business structure, financial trends, non-business income, documents, and advisors. These subsections are designed to help the family gather all the information necessary to facilitate open and honest communication among family members. Families that work through this section will have a solid foundation of shared information upon which to build trust and knowledge about the business, the financial situation, and will give everyone involved full access to all pertinent documents. This section will also make working with an educator or advisor much easier, because much of the background information will be available here, resulting in much more efficient use of the advisor's time.

The third major section in AgTransitions is Vision and Goals. This section will help all involved parties clearly state and communicate their goals and vision, including the owner generation, and both the on-farm and off-farm successor generation or generations. Finally it facilitates finding and documenting common goals.

Perhaps the largest section in an AgTransitions plan is the Business Transfer section. This includes a discussion of what the owners or parents want to accomplish along with what the successors or children want to do. The subsections include the transfer of four major parts of the business. The first is the management transfer plan which is where the family can outline how and at what pace management authority for various functions including operations, personnel, control, and financial functions will be transferred to the successors. There is also a subsection to discuss transfer of ownership and in what order ownership of crop and livestock inventories, machinery, breeding livestock, real estate and other assets will be transferred. The third major part of the business that must be transferred is the income. How will income be transitioned from accruing to the owner generation to the successor generation and at what pace? Can the business support both generations or will off-farm income be necessary during part of the transition? The fourth part of the business that needs to be transferred is the labor. How and at what pace will the successor transition from being more like an employee to becoming the manager of the business?

AgTransitions also includes a Retirement section that helps the older generation think about what they will do in retirement, where they will live, what sources of income they will have and what will be their retirement budget. This section also has subsections to discuss health care, long-term care, along with family and community support. There is also a subsection that helps put all of the parts of the retirement plan into a timetable.

The final section of AgTransitions is called Estate Plan Preparation. Estate planning often requires the services of an attorney, but the attorney fees can be reduced if the family goes to the attorney prepared. The subsections in the Estate Plan Preparation section help families do exactly that, get prepared to work with an attorney. This section will help the family outline how they want both business and non-business assets distributed, and what they want to have happen.

AgTransistions provides a list of documents commonly needed as part of an estate plan and discusses what each one accomplishes for the family. Finally it helps the family think through the tax considerations of transferring their assets. Specific documents are not provided, since many of these topics are very specific to individual states or countries, but the issues and requirements are similar across states or countries.

6. AgTransitions features

In addition to the detailed outline, AgTransitions provides Tips or suggestions for each topic in the outline. Tips are short but helpful suggestions that give producers insight into what should be included in each section of the plan and should also help them determine if the section is relevant to their business.

In addition to Tips, AgTransitions also provides Resources, which are links to web-based articles or factsheets providing more in-depth information for topics in the outline than what is provided by the Tips. Resources provide producers the ability to quickly learn more about topics of interest to them or topics that they feel the need to learn more about. For example, the management transfer subsection has links to several articles that discuss topics such as "Are you Transferring Management?", Developing the Next Generation of Managers", and Transferring Business Management". A sample transition plan is also available to help producers understand how to complete their individual plan.

One of the most innovative featured of AgTransitions is the ability producers have to allow multiple family members or advisors access to their plans and to allow them to comment on or edit the plan. All a producer needs to do to provide someone else access to their plan is to enter the person's email address into AgTransitions and select the level of access allowed. Other people with access to the plan are called reviewers in AgTranstions. A producer can allow a reviewer comment only access or comment and editing access. For example, maybe family members all want the ability to edit the plan, but they do not want an advisor to have editing capabilities. The family member who created the plan in AgTransitions has the flexibility to set each reviewer's capabilities. When the plan owner enters an email address, the reviewer will receive an email stating that they have been given access to the transition plan. An unlimited number of reviewers can be given access to the plan.

Producers also have the ability within AgTransitions to send emails to reviewers. If a producer has been working on a section of the plan and wants one or more reviewers to take a look at what has been written, he can click send email and ask for a review of the work just completed. The reviewer can add comments in the comment box or, if given edit privileges, can edit the plan.

The AgTransitions editor has all of the normal word processing features available such as copy, cut, paste, spell check, etc. Images or tables can be imported into the plan or added to the plan as attachments. An outline is produced by AgTransitions that includes the titles the producer assigns to each attachment.

Individual producers and their families can easily find and use AgTransitions online, but it is best used in conjunction with an advisor or workshop. Increasingly educators are using AgTransitions in workshops and educational programs. AgTransitions provides a tool that educators can provide to workshop participants that will help them work through all the components of developing a farm transition plan.

2020: PLANNING FOR THE BUSINESS MANAGEMENT NEEDS OF CANADIAN FARMERS - WHEN YOU DON'T KNOW WHAT YOU DON'T KNOW

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Farm Management Canada (FMC)

Abstract

The 2011 Census of Agriculture shows the number of farms and farmers in Canada is declining. While the world calls upon farmers for increased productivity, farmers face intensifying volatility from the marketplace, weather and in consumer trends and must manage the social, economic and environmental impacts of farming like never before. As agriculture continues to prioritize production management over business management, farmers will continue to struggle against an increasingly volatile and complex sector. Furthermore, with a reduction in Government programming to manage risk, now more than ever, Canadian farmers will have to rely on their business management skills to not only stay in business, but to succeed. In an ever-changing and complex industry, business management provides a solid foothold for farmers to confront change with confidence, manage risk, seize opportunity and make informed decisions. This signals an opportunity to improve the awareness and adoption of beneficial management practices, and further, to demonstrate the tangible results of adopting beneficial management practices. Indeed, success will be increasingly reliant on the business management skills of the farmer. Farm Management Canada is the only national organization dedicated exclusively to the development and distribution of business management information to Canadian farmers. In fulfilling its mandate to increase farmers' awareness and adoption of beneficial management practices towards the realization of business goals, FMC must be in tune with both the learning preferences and practices of farmers to meet their learning needs with not only the information they want, when they want it, and how they want it, but also the information they need. This paper focuses on a report commissioned by Farm Management Canada titled 2020: Planning for the Business Management Needs of Canadian Farmers and Farm Management Canada's efforts to meet these needs through diverse, multi-faceted and multi-medium knowledge transfer programming.

Keywords: farm business management, skills development, Canada

1. Introduction

The 2011 Census of Agriculture[1] shows the number of farms and farmers in Canada is declining. In fact, compared to 2006, the number of farm operators fell by 33,135 or 10.1% to 293,925, while the number of farms decreased by 10.3% to 205,730 census farms.

While the world calls upon farmers for increased productivity, farmers face intensifying volatility from the marketplace, weather and consumer trends, and must manage the social, economic and environmental impacts of farming like never before. Indeed, compared to all other sectors, in a recent KPMG study[2], the food and beverage sector ranked not only the highest in risk, but disappointingly, the lowest in readiness (or preparedness to manage risk).

As agriculture continues to prioritize production management over business management, farmers will continue to struggle against an increasingly volatile and complex sector. Further-

[1] 2011 Census of Agriculture. Statistics Canada. <http://www.statcan.gc.ca/ca-ra2011/index-eng.htm>

more, with a reduction in Government programming to manage risk introduced in 2013 with the new agricultural policy framework Growing Forward 2, now more than ever, Canadian farmers will have to rely on their business management skills to not only stay in business, but to succeed.

In an ever-changing and complex industry, business management provides a solid foothold for farmers to confront change with confidence, manage risk, seize opportunity and make informed decisions. This signals an opportunity to improve the awareness and adoption of beneficial management practices, and further, to demonstrate the tangible results of adopting beneficial management practices. Indeed, success will be increasingly reliant on the business management skills of the farmer.

Farm Management Canada is the only national organization dedicated exclusively to the development and distribution of business management information to Canadian farmers.

In fulfilling its mandate to increase farmers' awareness and adoption of beneficial management practices towards the realization of business goals, FMC must be in tune with both the learning preferences and practices of farmers to meet their learning needs with not only the information they want, when they want it, and how they want it, but also the information they need.

While serving as the United States Secretary of Defense, Donald Rumsfeld famously remarked:

- There are known knowns; there are things we know that we know.
- There are known unknowns; that is to say there are things that, we now know we don't know.
- But there are also unknown unknowns – there are things we do not know, we don't know[3].

Since its inception in 1992, Farm Management Canada has derived its success from the realization that the "unknown unknowns" apply at both the organizational level and just as well, to farmers.

In the first instance, we simply don't know what we don't know. And so, we endeavour to ask farmers "What do you want? What do you need? How do you need it?" Enter the second instance, whereby we may wish to ask ourselves – do the farmers know what they need and how they need it?

This paper focuses on a report commissioned by Farm Management Canada titled *2020: Planning for the Business Management Needs of Canadian Farmers*[4] and Farm Management Canada's efforts to meet these needs through diverse, multi-faceted and multi-medium knowledge transfer programming.

2. Background and methodology

Farm Management Canada started as the Canadian Farm Business Management Council in 1992 following a Federal-Provincial-Territorial call for a national coordinating body for farm business management activity in Canada that is unbiased and credible.

Governed by farmers and key stakeholders who set the strategic direction for the organization in response to the evolving agricultural sector, FMC is dedicated to the development and dissemination of farm business management information, resources and tools to position Canada's farmers for success.

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2 KPMG International (2012). Expect the Unexpected: Building business value in a changing world. <http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/building-business-value-part-2.pdf>

3 Defense.gov News Transcript: DoD News Briefing – Secretary Rumsfeld and Gen. Myers, United States Department of Defense. 2002. <http://www.defense.gov/transcripts/transcript.aspx?transcriptid=2636>

4 Maynard, H. and Scholz. A.N. 2020: Planning for the Business Management Needs of Canadian Farmers. Farm Management Canada. June 2012. <http://www.fmc-gac.com/publications/2020-planning-business-management-needs-canadian-farmers>

FMC connects multiple, diverse industry stakeholders aimed at achieving collaboration to leverage resources and avoid duplication of efforts.

In 2010, FMC began a thorough review of its operations and activities to embrace a new strategic direction and new ways to engage Canada's farmers in farm business management. In the context of meeting the business management needs of Canada's farmers, FMC commissioned a research project to identify the business management needs of Canadian farmers including content, access and delivery of current programming using existing consultations and assessment efforts, and furthermore, to identify gaps and opportunities both in programming and consultation efforts.

In June 2012, FMC released *2020: Planning for the Business Management Needs of Canadian Farmers* (hereafter referred to as the 2020 Report): a summary report of needs assessments and consultations conducted over the past five years (2006-2011) to share project results including best practices for delivering business management programming to Canadian farmers and recommendations to fulfill identified needs.

3. Adoption of business management practices by Canadian farmers

Adoption of business management practices is preceded by awareness of the benefits of business management and how individual farmers can implement and manage business practices on the farm.

Thusly, we look at the acquisition of knowledge in terms of 3 key factors:

- Content (what's needed),
- Access (where it's needed),
- Delivery (how it's needed).

Overall project findings conclude there is no shortage of content (material available), or major barriers to access information and resources. There is however a noticeable lack of understanding and appreciation for the benefits of farm business management. According to the *Baseline Study on Farm Business Management Planning in Ontario*[5] by the Agricultural Management Institute located in central Canada, 75% of Ontario farmers recognize the importance of planning, however 78% have never undertaken any formal planning (business, financial, succession) and 43% cite 'no need/interest' as the top reason for no formal business plan. And further, farmers do not seem to be translating the information available into adopting beneficial management practices and changing behaviour at the farm level.

The problem thusly lies in lack of uptake, which may equally be attributed to a lack of awareness and promotion of the importance of business management, resources available, and how such resources apply to and can be used by individual farmers.

Therefore, emphasis must be placed on the delivery of information including not only the content, but the promotion thereof to speak to individual needs. Due to regionalization, different production and market structures, variability in farm size, different approaches to program delivery and multi-level program delivery, Canadian farmers represent an overwhelming amount of diversity. The diversity of Canadian farmers is reflected also in learning styles and frames of reference when it comes to adopting beneficial management practices.

With such immense diversity, a coordinated, comprehensive approach to knowledge transfer is needed.

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5 Agricultural Management Institute. (2011). Baseline Study on Farm Business Management Planning in Ontario. <www.takeanewapproach.ca>

4. Defining business management

4.1. To quote Lewis Carroll, we must "begin at the beginning[6]"

While experts agree that over and above production skills, the success of any farm enterprise is directly related to the business management skills of the farm manager, in Canada, business management continues to suffer from an identity crisis whereby there is no set, agreed-upon definition for business management. The 2020 Report authors suggest the following definition: *the function which deals with the analysis of the farming resources, alternatives, choices and opportunities within the framework of resource restrictions, social responsibilities and personal constraints*[7].

However, in recognition of the lack of consideration for the human side of the farm business, further suggest the following definition of business management as it relates to farming: *a discipline that deals with people, decision-makers and organizations in respect of farms and agricultural production. It is a people-oriented focus and function rather than a production focus on crops or livestock*[8].

Whereby the latter definition dichotomizes management in terms of people distinct from crops and livestock, business management's place in production management is neglected. Perhaps the optimal definition moving forward is to marry the concept of human resources to resources in the first instance whereby farmers and agricultural stakeholders as a whole must be conscious of the resources – human, financial, social, environmental, etc. – available and how best to utilize and manage such resources for maximum effectiveness and efficiency in managing the farm business for sustainability.

Rather than a separate entity, business management must co-exist and underlay production management as managerial concepts distill to their fundamental elements – managing resources to sustain practice.

Farmers and industry stakeholders alike must firstly be able to see, and secondly, create the link between production and business management before real change will take place.

5. The business management needs of canada's farmers

Key findings from the 2020 Report indicate that Canadian farmers desire skills related to acquiring, organizing and accessing information to make confident business decisions. Thusly, skills development does not only relate to the content (for example, having a business plan), but further, to effectively acquiring and using knowledge (learning how to create, implement and manage the business plan, and what other resources are available and become relevant to incorporate along the way). This supports our earlier supposition that emphasis must be placed on the delivery of information including not only the content, but the promotion thereof to speak to individual needs.

Indeed, current knowledge transfer systems only work well for those farm managers who are self-motivated and/or skilled self-learners. We must therefore take a look at our information delivery systems including learning formats as they relate to the learning preferences and practices of the individual farmer - not only the information they want, when they want it, and how they want it, but also the information they need.

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6 Carroll, L. (1865) Alice's Adventures in Wonderland, London, England: Macmillan Publishing Co.

7 Adapted from <http://krishiworld.com/2012/06/15/maximizing-profits-from-the-farm-business-using-farm-management-part-1/>

8 Adapted from <http://krishiworld.com/2012/06/15/maximizing-profits-from-the-farm-business-using-farm-management-part-1/>

Question – *do the farmers know what they need and how they need it?*

Rumsfeld's "unknown unknowns" in relation to the things that we do not know that we don't know become increasingly important in knowledge transfer and skills development as we must evolve beyond the "one-size-fits-all" format to the provision of highly individualized farm business management resources, tools and information.

6. Meeting the business management needs of canada's farmers – a look at current practices

General Report findings divide business management educational programming into 3 categories:

- Formal Programs,
- Informal Programs,
- Informational Programs and Services.

Formal Programs are defined as programs offered by an educational institution that provides some kind of accreditation upon completion by way of degree, diploma, or certificate. While there is a wide range of agricultural programs in Canada, very few include substantive farm business management content, and fewer focus on topics outside of financial analysis and profitability.

Informal Programs are defined as programs that have some form of training but are not accompanied by a formal accreditation process; generally these are a series of individual courses or an aggregation of workshops. There are very few programs of this kind in Canada. And, less now than in previous years. However, of the programs that currently exist, such as the George Morris Centre's Canadian Total Excellence in Agricultural Management program, registration and completion rates remain high, and such programs are highly regarded by participants.

Informational Programs and Services are programs that raise awareness and improve understanding through resource materials, websites, conferences, webinars, etc. By and large, this type of educational programming is most prominent in Canada, especially as a mechanism for lifelong learning and continuous education following graduation from a formal institution in one's formative years.

Given that resources are limited both in terms of dollars available to develop business management learning resources and the time available for Canadian farmers' to take advantage of such learning opportunities, it is vitally important that educational programs connect and correspond. Furthermore, farmers are expressing a desire for a navigated path through the educational resources available as they express the need for skills related to acquiring, organizing and accessing information.

Not only is it vitally important for such programs to offer adequate educational programming in farm business management, but to also instill a culture of lifelong learning and continuous education in Canada's farmers so that they are driven to be entrepreneurial leaders, driving excellence in Canadian agriculture throughout their farming career.

7. Best practices for farm business management skills development

The 2020 Report identifies a handful of recommendations concerning farm business management skills development.

- Communicate tangible benefits reaching beyond economic to environmental and social goals that respond to the personal values of farmers.

- Start small, but get started – simplify skills development into bite-size pieces for easier digestion and comprehension.
- Provide a navigated path to achievement – establish small sequential steps with closer goals for instant gratification to build the momentum for continuance.
- Forget a one-size-fits-all approach – the sector is too variable (farm size, type, region, etc.) – provide targeted information and delivery to which the audience can relate (ex. farmer to farmer).
- Incentify through accreditation, recognition and tangible return on investment
- Embrace communication technology and innovation to reach new audiences in new ways (ex. social media).
- Encourage group activity for collective intelligence and healthy competitiveness through benchmarking and comparison.
- Ensure an element of implementation and follow-up providing continuance and commitment, including use of professional and personal support (advisor, facilitator, mentor etc.).
- Incorporate a learning program for ongoing, multi-stage development and continuous education.

Turning attention to the international farm management community garners further best practices including:

- Embracing agri-food value-chains (more successful internationally than in Canada).
- Using hired external 'general managers' to run the farm (Canada's average farmer is owner/operator/manager). Canada is beginning to embrace using Boards of Directors and Advisory Councils.

While all of the above best practices specifically relate to how educators can seek to succeed in business skills development for the agricultural sector, one must also observe that these best practices are ground sustainable practices; a sustainable development program for the farmer akin to a sustainable growth and development program for the farm business.

8. Business management: FMC's coordinated, comprehensive approach

Following the conclusions and recommendations of the 2020 Report, Farm Management Canada now consciously operates as a knowledge-based organization, i.e. an organization whose core competency resides in the collection, development and transfer of farm business management knowledge, to ensure its availability to and create value for farmers and other industry stakeholders, as well as advocate for the adoption of beneficial management practices.

While the ultimate target group for business knowledge transfer and skills development is farmers, by providing information and services to those who provide support services to farmers, FMC can extend its reach and impact, and work towards coordinating industry efforts. Furthermore, in an effort to appeal to individual needs and values, information provided by and through a familiar source such as a local farm organization may result in better receptivity of information.

Given the breadth and scope of farm business management, farmers oftentimes feel overwhelmed, do not know where to start, where they are going and where they will end up, and… if it is where they want to be. Using a comprehensive, coordinated approach to learning coupled with diverse learning formats provides a specialized, navigated path to skills development.

Over the past year, FMC has adopted a learning architecture framework (Figure 1) to identify the skill areas required by farm managers and map those requirements to existing resources both in content and format, to address the acquisition of knowledge in terms of content, access and delivery.

This learning architecture provides farmers with a navigated path through business management starting with business planning, situated at the forefront of business management as the focal point and key element of farm business management that ties all other components together. The

Figure 1. FMC's Whole farm Plan

learning architecture has precipitated FMC's Whole Farm Plan, which takes a comprehensive approach to connecting all of the facets of business management into a single management system.

FMC is on a steady path to updating existing and creating new resources in new formats to meet the learning preferences, practices and needs of Canada's farmers.

9. Something for everyone

If our ultimate goal is to change behaviour at the farm level (ex. enhance farm management skills) we must embrace the Barnum Principle (something for everyone) not only recognizing the farmer, but also those who train, educate and advise farmers through "train the trainer" techniques.

Through its multi-medium learning program, FMC can package and present information, resources and tools in delivery formats suited to different learning styles, availability, and personal interest, reaching stakeholders from all demographics, crossing production sector, farm size, and business stage in Canada's official languages, from coast to coast to coast.

This diverse audience including a vast partnership network of farmers, advisors, academics, government, corporations and fellow organizations, helps build a nationally-coordinated effort to increase the business management skills of farmers, and ultimately, change behaviour at the farm level.

10. FMC's integrated, multi-medium learning program

Since 2010 and the completion of the 2020 Report, FMC has been on a steady path of developing a multitude of learning platforms that allow for complementary learning that extends beyond a single initiative or learning event. FMC's knowledge management and transfer mechanisms use multimedia, including but not limited to:

- Social Media: Twitter, Facebook, YouTube,
- Smartphone, Mobile Technology,
- Online Repositories/Databases,
- Webinars from Industry Experts,
- Bi-Monthly Magazine sharing Farmer Success Stories,
- Online Weekly Newsletter including Announcements, Events, Opportunities,
- Resources/Publications/Tools,
- Mentorship Program,
- Scholarships,
- Speaking Engagements/Industry Presentations,
- Research, Reports, Analysis,

Any topic can be run through these channels, creating a multi-medium learning experience that meets the learning preferences and practices of diverse stakeholders.

As an example, a Business Planning learning program can use a combination of a hardcopy resource, information webinars, a dedicated Twitter chat, web articles and an online database of sample business plans to not only raise awareness of the benefits of the management practice, but also walk farmers through the "how-to" towards adopting the business practice. Furthermore, FMC could work with a specific regional or commodity group to increase the relevance of that particular learning program to a specified target audience such as blueberry farmers on the West coast.

11. Redefining relationships, creating conversations

For all of the learning opportunities and those dedicated to lifelong learning and continuous education, sharing best practices and resources, information and tools, communication technology is making the world a smaller place and it is becoming much easier to connect and stay connected, building a network of like-minded people around you and your business. This is true for farmers, much as it is true for Farm Management Canada. Social media brings information exchange into a new era of instant gratification, responsiveness and immediate feedback from places like the Twitterverse. Farmers are using it to seek best practices from fellow farmers who have "been there, done that" and have valuable lessons to share, while organizations have a new way to interact with stakeholders with a timeliness like never before.

12. Conclusions and outcomes

In the context of business skills development and changing behaviour at the farm level, the 'unknown unknowns' become the discrepancy between what one thinks they do versus what actually happens, which translates into a discrepancy between what they may want versus what they need. In order to ensure relevant programming and services, FMC evaluates its activities on an ongoing basis within the context of market trends and opportunities, including farmer preferences and practices.

It is in the course of stakeholder engagement and evaluating products and services over the past 3 years that FMC has devised a navigated path from awareness to implementation (Figure 2) of beneficial management practices. FMC will continue to redefine business management using a comprehensive framework while raising the profile of business management within the context of agriculture and production management, linking management to personal values, lifestyle, and everyday farming.

Farm Business Management: Navigating the Path from Awareness to Implementation

- Exposure
  - Self-Assessment
    - Group Assessment/Learning Opportunity
      - Walk-Throughs
        - One-on-One Consultation
          - Action Planning
            - Follow-Up
              - Ongoing Information and Resource Gathering
                - Plan for Continuous Learning

Figure 2. Navigated path from awareness to implementation of beneficial management practices

In fulfilling its mandate to increase farmers' awareness and adoption of beneficial management practices towards realization of business goals, FMC will continue to embrace communication technologies to stay in tune with both the learning preferences and practices of farmers to meet their learning needs with not only the information they want, when they want it, and how they want it, but also the information they need.

13. Farm Management Canada Funding

Farm Management Canada is funded in part by Agriculture & Agri-Food Canada under the Growing Forward program, a federal-provincial-territorial initiatives, and a growing number of partners. With this support, FMC is fulfilling a significant role in nurturing a thriving Canadian agriculture industry.

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RISKS, ATTITUDES AND SOURCES OF INFORMATION OF LARGE-SCALE CORN BELT FARMERS

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Abstract

The transfer of innovations and knowledge to farmers can be improved by increased understanding of farmers' decision making and their sources of information. To assist, farmers attending the Purdue University Top Farmer Crop Workshops (TFCW) have responded to brief questionnaires. Participants in the 1991, 2001 and 2012 TFCWs were asked to rate sources of and managerial responses to risk and the value of different sources of information. Production, marketing or price, financial, legal and human risks were included. TFCW participants are younger, have more years of education and operate much larger than average farms. Likert-type scales from 1 (low) to 5 (high) were used for rating. Not unexpectedly, prices were consistently a highly rated source of risk. The importance of yields declined over time, and there were considerable changes in other rankings. Similar results were found for responses to risk. The increase in importance of crop/revenue insurance was striking. Ratings of value of information sources generally increased from 1991 to 2001 and then declined in 2012. These results suggest that producers themselves, educators and others working with farmers need to review producers' perceptions frequently because only change is certain.

Keywords: risk, risk management, agricultural risk, information

1. Introduction

Farming is a dynamic industry. Farmers and agribusinesses face risks which come from traditional sources as well as risks from new and unexpected directions. Farmers must react to frequent changes in the prices and quantities of agricultural commodities. Innovations in technology, such as genetically modified varieties of crops and other organisms, may require changes in both the production and marketing systems to meet the requirements of the consumers. The economic environment, both domestically and internationally, is seldom static. In addition to farmers, other individuals and institutions serving agriculture need to be aware of these nearly constant changes and their effects on the agricultural sector. This paper reports some results of surveys conducted with large-scale grain producers in the eastern US Corn Belt during the 1991 to 2012 period. These surveys emphasized producers' ratings of the importance of various sources of risk in their farm decision-making. Farmers' ratings of the importance of responses to risk and their sources of information, including consultants, are also included.

The first section of the paper briefly discusses the procedures used to collect the risk-related information and some characteristics of the respondents. The respondents, participants in an annual three-day conference/workshop at Purdue University, are not a statistically representative sample of all farmers. However, the views and opinions of workshop participants are considered typical of large-scale com-

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mercial producers who will be producing the bulk of commodities in the future. The second section presents the ratings of the importance of various sources of risk by participants in the 1991, 2001 and 2012 workshops. Similar rating type information was obtained from producers for possible managerial responses to risk, sources of information, and the role of consultants in the following sections. The final section draws some implications for producers and for those serving the agricultural sector.

2. Procedures

Purdue University has conducted a three-day conference/workshop, the Top Farmer Crop Workshop (TFCW), for agricultural producers in July for about 45 years. The TFCW has focused largely on new and developing technology in production and economics of grain production in the eastern Corn Belt (Ohio, Indiana, Illinois, and Iowa). Participants have had the opportunity to use a mathematical programming model to analyze timeliness in their planting and harvesting, returns to additional land and other issues for their individual farm operations. Participants have often been asked to complete a questionnaire which generally includes some basic information about the farm and farm operator as well as some topics of current interest (i.e., tillage changes, marketing practices, flexible cash rents, and crop insurance). Information on the sources of and responses to risk has been a regular part of the questionnaire. Ratings of information sources had been part of the 1991 and 2001 questionnaires and an update was included in the 2012 TFCW. It is common for more than one individual to be involved in the management of these large- scale farm operations and to attend a workshop. In these cases, one participant per farm operation was asked to complete the questionnaire and return it during the workshop. Only questionnaires of active farmers with a gross farm income of $100,000 or more were included in the analysis. There were 80 useable responses in 1991, 39 in 2001 and 37 in 2012.

Table 1 summarizes information about the respondents from 1991, 2001 and 2012 TFCWs and their farm operations. The TFCW participants are not a statistically representative sample of farmers. Some farmers attend the workshop each year, but most would attend for 2-3 years and

Table 1. Means and Standard Deviations of Selected Operator and Farm Characteristics of 1991, 2001 and 2012 TFCW Participants

Variable	1991 N = 80	2001 N = 38	2012 N = 37
Age of operator	41.1[b] (10.2)	48.1[a] (11.2)	52.7[a] (13.4)
Years of education	14.8[a] (1.8)	15.5[a] (1.4)	15.2[a] (2.0)
Hectares of crops	736.5[c] (514.2)	931.4[b] 665.2)	1271.1[a] (905.4)
% of crop land owned	36.2[a] (28.6)	32.2[a] (26.9)	35.8[a] (26.4)
% debt on farm	21.1[a] (15.0)	24.5[a] (13.6)	22.3[a] (16.80
Willingness to bear risks	3.8[a] (1.0)	3.6[a] (0.7)	3.7[a] (0.9)
Skill in management	3.9[a] (0.7)	3.8[a] (0.6)	3.9[a] (0.6)

[1] Numbers in a row with the same superscript letter are not significantly different

then return when they were considering major changes in their operation. The average producer responding in 2012 operated over 1,271 hectares of crops, primarily corn and soybeans, up from 736 hectares in 1991 and 931 hectares in 2001. The USDA estimates, based 2007 Census of Agriculture, the large family farm category had an average of 844 hectares and the average US farm has about 195 hectares. The TFCW participants reporting gross farm income of more than $2,000,000 increased from 11.7% in 1991 to 41.2% in 2012. Although there was a large increase in farm size over the period, the percentage of crop land owned and percent debt in the farm operation were not significantly different. The major changes in the size of farms occurring had little effect of the financial structure of farming.

Average age of the respondents increased significantly from 41.1 years in 1991 to 52.7 in 2012. This is still below the average age of 57 for US farmers but reflects some "graying" of farm operators on these large-scale farms. The number of years of education completed by the TFCW respondents was nearly constant and approaching the 16 year level that is considered equivalent to graduation from college. Their educational level was considerably above the average US farmer. Respondents were asked to rate themselves, relative to other farmers, on their willingness to take risks and their management skills. Their responses on the Likert-type scales of 1 (low) to 5 (high) ranged from 3.8 to 3.9 and were above the mid-point of the scale and were almost identical across years. There were statistically significant positive relationships between the scales indicating higher skill in management was associated with greater willingness to take risks. Thus, differences in decisions which might be attributed to producers' attitudes toward risk may be reflecting their perceived management skills.

3. Sources of risk

The sources of risk for farm operations can be categorized in a number of different ways. It is common to classify the risks faced by producers into the five categories of production, market or price, financial, legal, and human risk. Yields and technology are directly related to production risk, while crop prices reflect the market risk. Input costs, costs of capital items, interest rates and credit availability are related to financial risk. Changes in the government commodity programs and environmental regulations are risks in the legal area. Some aspects of the human risk include something unforeseen happening to the operator, changes in family relationships (e.g. divorce or "falling outs"), and labor provided by family (e.g., new baby, child comes home to farm).

Risks, as typically conceptualized, involve negative outcomes (i.e., revenue less than budgeted). A variety of "what–if" scenarios do need to be considered in decision-making. However, sometimes actual outcomes may be much better than expected and should not be ignored. In this case, failure to be able to take advantage of the opportunity may be costly. The probability associated with the upside risk is generally low, but should not be ignored.

Participants in the TFCWs were asked to indicate the importance of a number of sources of risk to their farm firm decision-making on a 5-point Likert-type scale on which 1 was not important and 5 was very important. Table 2 presents the means and standard deviations of 13 sources of risk for participants in the 1991, 2001 and 2012 TFCW surveys. The sources of risk are listed in descending order of their ratings in 1991.

Crop prices were the highest rated source of risk in 1991 and were second in both 2001 and 2012 with no statistically significant differences among years. Crop yields were rated second in 1991, but declined to fourth in 2001 and sixth in 2012. Crop yields tended to follow trend yields closely. Until the disaster of 2012, farmers and others thought most US yield variability had been eliminated by improved varieties. Injury, illness or death of the operator ranked third in 1991 and declined some in later years. Government commodity programs ranked first as a source of risk in 2001 and declined a full point in the ratings and ranked 12th in 2012. This decline in ratings of government commodity programs was closely associated with the increase in market prices. Government environmental regulation was the highest rated source in 2012 after having had significantly lower ratings in 1991 and 2001. This suggests increasing concern by farmers that limitations may be placed on the use of fertilizers and pesticides. Input prices ranked in the top half of the sources of risk in all three surveys.

Changes in family relationships and family labor were generally not rated as important sources of risk for farmers. However, the standard deviations of the ratings of some of the family related sources of risk were relatively large. This indicates a large variation in responses and suggests that these sources of risk may be very important for some families and not important for other families.

The average ratings of the 13 sources of risk were not significantly different across periods. This suggests that producers did not vary greatly over time in their evaluation of the overall riskiness of agriculture. However there were significant changes in the both the ratings and rankings

Table 2. Means and Standard Deviations of Ratings of Importance of Sources of Risk for TFCW Participants in 1991, 2011 and 2012[1,2]

Source of Risk or Uncertainty	1991 N = 80	2011 N = 39	2012 N = 37
Crop prices	4.31[a] (0.87)	4.31[a] (0.80)	4.08[a] (0.89)
Crop yields	4.21[a] (0.91)	4.08[a] (0.73)	3.84[a] (1.04)
Injury, illness or death of the operator	3.86[a] (1.30)	3.82[a] (1.17)	3.94[a] (1.17)
Government commodity programs	3.83[b] (1.08)	4.38[a] (0.67)	3.38[c] (1.23)
Government environmental regulations	3.81[a] (1.03)	3.72[a] (0.89)	4.19[a] (0.70)
Cost of inputs	3.70[b] (0.89)	4.13[a] (0.70)	3.97[b] (0.97)
Cost of capital goods	3.66[b] (0.94)	3.66[b] (0.85)	4.03[a] (0.77)
Technology	3.54[a] (1.03)	3.56[a] (0.79)	3.58[a] (0.81)
Interest rates	3.48[a] (1.09)	3.41[a] (1.07)	3.74[a] (1.01)
Family relationships	3.36[a] (1.42)	3.13[a] (1.44)	3.42[a] (1.25)
Land rents	3.18[b] (1.16)	3.71[a] (1.18)	3.78[a] (1.07)
Credit availability	3.05[b] (1.29)	2.92[b] (1.11)	3.61[a] (1.20)
Family labor force	2.96[a] (1.28)	2.82[a] (1.19)	3.14[a] (1.22)
Average of 13 sources of risk	3.61[a] (0.60)	3.68[a] (0.47)	3.72[a] (0.56)

[1] TFCW participants responded on a Likert-type scale at 1 (very unimportant) to 5 (very important) in responding to risk; [2] Numbers in a row with the same superscript letters are not significantly different

of many of the specific sources of risk. Crop prices, crop yields and input costs consistently were the higher rated sources of risk for farmers. Considerable concern has been expressed by Extension personnel and others working with farmers on the absolute level and year-to-year changes in crop land rent. Farmers never rated land rent above 3.78 on the 5-point source of risk scale. This suggests that rentals to family members, flexible cash leases and informal, long-term leases mute the variability of land rents and their importance as a source of risk for many individual producers.

4. Responses to risk

Producers may make a variety of responses to manage their risks. It is likely that farmers are concerned about the events which may have the largest impact of the businesses and these concerns may change over time. In broad terms, the 1991 survey was taken in a period of adjustment to new weed control and tillage practices. The 2001 survey was taken at a time when farmers were stressing marketing practices. Commodity prices had declined relative to the earlier period of farmers seeking "Freedom to Farm." The 2012 period was a period of higher prices for both commodities and inputs. However, the survey was conducted in early July 2012, this was just before the drought became severe and crop prices increased sharply.

TFCW participants were asked to evaluate 15 managerial responses to risk on a 5-point Likert-type scale. As discussed previously, a 1 indicates that the managerial response is not important and a 5 indicated the managerial response was very important to the respondent. The managerial responses considered all five areas of risk. However, there was not necessarily a direct correspondence between the source of risk and the response. For example, yield variability may be a source of risk. A direct management effect might be the use of irrigation by a farmer to reduce variability of actual yields. In contrast, another farmer might use crop insurance to ameliorate the financial consequences of yield variability. The distribution of yields is unchanged, but distribution of net revenue is improved. In both situations, some risk management has been achieved.

Table 3 presents the means and standard deviations of 15 responses to risk for participants in the 1991, 2001 and 2012 TFCW surveys. The responses to risk are listed in descending order of their ratings in 1991. The average ratings of the 15 responses were not significantly different across the three TFCWs. Being a low-cost producer, using debt-leverage management and maintaining financial reserves were the top three risk responses and were followed by cash forward contracts and life insurance for key personnel for the 1991 TFCW. Participating in the government commodity program, being a low cost producer and cash forward contracting became the top rated responses in 2001.

It is interesting to note the substantial increase in the rating of crop/revenue insurance and the very large decline in the importance of the government program between 2001 and 2012. The government made major changes in farm policy which were recognized and acted upon by farmers. Farmers purchased revenue insurance for the 2012 crops in record numbers, and significant numbers received insurance indemnities. Given the continuation of subsidies to crop insurance and greater emphasis in farm policy, there is likely to be increased use in the future. There were a number of marketing related responses and their ratings have tended to increase over time. Cash forward contracting, hedging with futures, minimum price contracts and options require different skills of producers and will affect future activities. Off-farm investments rate higher than off-farm employment by these large-scale producers. However, for small-scale producers, this ranking is likely to be reversed.

Table 3. Means and Standard Deviations of Ratings of Importance of Responses to Risk by the 1991, 2001 and 2012 TFCW Participants.[1, 2]

Risk Management Response	1991 N = 80	2001 N = 39	2012 N = 37
Being a low-cost producer	4.26[a] (0.88)	4.35[a] (0.75)	3.93[a] (0.97)
Debt-leverage management	3.93[a] (1.14)	3.50[a] (1.06)	3.69[a] (1.23)
Maintaining financial/credit reserve	3.93[a] (0.94)	3.58[a] (1.03)	3.58[a] (1.13)
Cash forward contracting	3.86[b] (1.00)	4.21[a] (0.74)	3.47[b] (1.23)
Producing specialty crop or crop under contract	3.86[a] (1.00)	2.97[b] (1.42)	2.81[b] (1.28)
Government program participation	3.78[b] (1.10)	4.50[a] (0.73)	2.92[c] (1.30)
Diversification of enterprises	3.60[a] (1.09)	3.70[a] (1.02)	3.42[a] (0.97)
Hedging prices with futures contracts	3.21[b] (1.26)	3.87[a] (0.99)	3.86[a] (0.99)
Life insurance for key personnel	3.17[a] (1.46)	3.62[a] (1.21)	3.40[a] (1.45)
Geographic dispersion of production	3.11[a] (1.08)	2.83[a] (1.08)	3.00[a] (0.99)
Commodity options	2.70[b] (1.28)	3.55[a] (0.98)	3.03[b] (1.10)
Off-farm investments	2.64[b] (1.16)	3.26[a] (1.09)	3.20[a] (1.21)
Minimum price contract	2.49[a] (1.17)	2.62[a] (0.91)	2.72[a] (1.19)
Crop yield/revenue insurance	2.18[c] (1.31)	3.45[b] (1.22)	4.06[a] (1.18)
Off-farm employment	2.13[a] (1.29)	2.39[a] (1.44)	1.97[a] (1.20)
Using production practices which work under a variety of conditions	NA	3.69[a] (0.89)	4.00[a] (0.91)
Average of 15 responses to risk	3.24[a] (0.52)	3.47[a] (0.51)	3.27[a] (0.40)

[1] TFCW participants responded on a Likert-type scale of 1 (very unimportant) to 5 (very important);
[2] Numbers in a row with the same superscript letter are not significantly different

5. Sources of information

Information is essential in the decision-making process. For agricultural producers, decisions often involve assessment of new technology and production and marketing practices with only limited knowledge about the possible consequences. Early adopters of a successful innovation may gain a considerable economic advantage. Unsuccessful innovations can have many negative consequences. Consultants may be used by large-scale producers for a variety of reasons.

Consultants may be viewed as complement to or a substitute for the management skills of the agricultural producer. Liability issues and cost may also be factors affecting whether and how consultants are used.

Table 4 reports the means and standard deviations of farmers' ratings of the value of 10 sources of information for management decisions. The 1991 TFCW participant group rated only their own records and the internet and computerized information systems above 3.0, the mid-point of the rating scale. Ratings by the 2001 and 2012 TFCW groups were generally higher. Ratings of sales and support personnel increased sharply perhaps reflecting the "packages of technology" developed by agri-businesses. County Extension was the lowest rated source of information in 2012. The relatively higher ratings of state Extension staff and field days and conferences may reflect a possible bias. All of the respondents were attending a university on-campus workshop with a registration fee of $400 for 2013.

Because of inadequate time allocated for the questionnaire, responses on the costs and use of consultants by producers participating in the 2012 TFCW were incomplete. Use of professional assistance for accounting and tax preparation was very high among those responding. Given the complexity of US taxes, especially for farmers, this is not unexpected. Consultants in this area were rated at 3.65 on the 5-point Likert-type scale for the value information for management decisions. Producers indicated less use of consultants in the areas of production, marketing and management. Farmers' ratings of the value of information provided were 3.07, 3.18 and 3.24 for consultants in the production, marketing and management areas, respectively.

Table 4. Means and Standard Deviations of Ratings the Value for Management of Information Sources by Participants in the 1991, 2001 and 2012 TFCWs. [1]

Sources of Information	1991 N = 80	2001 N = 34	2012 N = 37
Farm magazines	2.65 (0.64)	3.00 (0.89)	2.97 (1.06)
Ag newsletters	2.86 (0.84)	3.03 (1.03)	2.77 (1.01)
County Extension	2.04 (0.92)	2.42 (1.13)	1.84 (0.97)
State Extension	2.98 (1.04)	3.34 (0.99)	3.19 (1.22)
Field days, conferences	2.73 (0.93)	3.38 (0.85)	3.39 (1.12)
Sales/support personnel	1.74 (0.57)	3.31 (0.98)	3.23 (1.09)
Lenders	2.26 (0.90)	2.72 (1.11)	2.77 (1.10)
Other producers	2.81 (0.98)	3.24 (0.91)	3.19 (1.06)
Internet/computer	3.10 (1.00)	3.68 (1.00)	3.31 (1.09)
Own records	4.30 (0.73)	4.37 (0.71)	3.84 (1.02)

[1] TFCW participants responded on a Likert-type scale of 1 (very unimportant) to 5 (very important)

6. Conclusions and implications

This study uses information collected from participants in the 1991, 2001 and 2012 TFCWs to identify sources of and responses to risk of the greatest importance to producers over time. What were the most important sources of and responses to risk also varied across producers. When producers consider a number of sources and responses to risk, the results demonstrate that there was considerable variation among producers at a specific point in time. There were also significant changes in ranking of the both the sources of and responses to risk. Similar patterns also were observed for sources of information.

The transfer of innovations and knowledge to agricultural producers is difficult. The near constant change in agriculture and risk further complicates the process. However, the process can be improved by increased understanding of the farmers' decision making. The specific results of this study may be of limited applicability. What is important is the recognition of the real differences in the views of producers over time. Knowledge of their sources of information can also be useful in planning educational programs, especially those programs with little or no direct contact between the individuals involved.

DIRECT DRILLING AS A TOOL IN CONSERVATION AGRICULTURE FOR SMALL FARMERS

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Abstract

The practice of Direct Drilling has become widely used during the past few decades as a means of conserving soil moisture and combating soil erosion. The most progress has been in the development of suitable large scale planting equipment designed for use in crop production on big farms sometimes extending to thousands of hectares. This tackle requires the largest tractors of several hundred horse power to be able to operate it: something which puts it completely out of reach of the small farmer. The latter may rely on contractors to plough his crop area or even own a small tractor himself. Usually the pre planting operation is with a disc plough followed by a disc harrowing. This can be extremely bad for the soil causing a breakdown of soil structure, the formation of plough pans and accelerated soil erosion.

In the last two years a prototype small direct planter has been developed to replace the disc plough for use with smaller tractors, something which has been rather neglected until now. This has been tried with success in Kenya and this presentation discusses work done to date; the challenges faced and the requirements for a large extension input to overcome the inherent resistance to change by farmers and the reasons for the latter.

Africa can ill afford to repeat the destruction of soils which has occurred in some other parts of the world and this paper aims to outline one method by which this may be achieved.

Keywords: conservation agriculture, smallholder, mechanised, zero tillage

1. Introduction

Conservation agriculture can be broadly defined as having three main components:

- minimum soil disturbance,
- maintenance of an organic soil cover,
- rotation of crops (Derpsch & Friedrich 2009).

In order to meet these criteria a wide range of planting equipment has been developed especially to meet the first two components. Most development by manufacturers has been for large scale machines capable of being used with the most highly powered tractors which is not relevant to small farm situations.

Considerable work has been carried out in the development of simple machines to be used with animal power or with small engines for self propulsion. (Sims & Kienzle 2006). A common method of land preparation in Kenya is disc ploughing with regular tractors followed by disc harrowing. This can lead to one of the most brutal treatments of soil especially, as is often the case, when the weather conditions are not suitable. However there does not appear to be much in the way of simple reasonably priced direct planting equipment to provide a sound alternative to the commonly used 3 furrow disc plough. One such simple direct planter, which could provide the answer, is described below.

Abbreviations: ADC: Agricultural Development Corporation, CA: Conservation Agriculture, DPRK: Democratic People's Republic of Korea, FAO: Food & Agriculture Organisation.

2. History of mechanised conservation farming in Kenya

This section is very much based on the author's personal experience when working with the ADC on large farms in the Rift Valley province in the 1980's. In the previous decade there had been the initiation of minimum and zero tillage development simultaneously in Brazil and Australia with a different emphasis and objectives in both Countries. In the former it was generally the concern over soil erosion in areas which generally receive adequate rainfall for crop production. In the latter it was the retention of soil moisture which was the key factor. Both are important in Kenya and throughout Africa.

At this time large areas of land were being opened up to cultivation on the grass plains of Ngorengore on land leased from the Masaai which in addition to the large scale ADC farms and other pockets of large farmers in the Mount Kenya region and Mau Narok provided a ready market for suitable minimum tillage equipment. The latter, because most of the influence on development in Kenya came from Australia with retention of soil moisture the primary concern. (Kenya may have been able to be a good example to Brazil in soil conservation in the form of contouring, bench terraces etc!) As farmers from Kenya visited Australia under the sponsorship of a chemical company who were marketing the new herbicide 'glyphosate' which can be a critical component of CA, they began to import minimum tillage machinery and a local company was established at Gilgil to manufacture similar equipment in Kenya.

This became a very successful business with a big increase in demand for both cultivation equipment and pneumatic seeders. At that time there was very little opportunity for smaller farmers to gain access to the new technology.

The writer was based outside Kenya for the next decade. During that time he worked for a short period in DPR Korea and could see the potential opportunity for a transition to more sustainable farming in that beleaguered Country. It is not a surprise to him to see the rapid successful development in no till farming that has taken place there in the last few years. Previous experience in the Southern part of Malawi where monoculture, continued ploughing and lack of animal input has led to an alarming decrease in crop yield due to declining fertility, had helped to develop his perspective.

On resuming regular visits to Kenya over the past decade the huge step forward in CA has become apparent and just recently the attempt to convert more farmers to using soil sustainable types of implements has been impressive but generally on a large scale.

3. To plough or not to plough

During his spell with ADC the writer often visited an elderly relative who farmed on Mount Kenya and engaged in great idealogical arguments on the merits or otherwise of the plough. Being a ploughing judge and on the committee of the National Ploughing organisation, this farmer was not to be persuaded that the plough could be a bad tool. Open minded at the time, the writer has to confess that twenty years on he has been converted to realising the damage that the plough can cause. His appreciation of this fact does not extend to the belief that the plough should be eliminated altogether as some zealots of CA would have us believe. What better implement than the disc plough for bringing into cultivation recently cleared 'bush land' or the mouldboard for preparing land which has been under grass leys for the subsequent arable part of the rotation.

It is the much greater awareness of the damage we are doing to our soils, the increasing attention to how we may rectify this and great strides in the development of technology that has persuaded him to alter his opinion.

The plough pan is probably the most deleterious of the disc plough's effects. It causes impeded soil drainage leading to poor crop growth, soil erosion and degeneration of soil structure. In order to combat this, one solution has been to resort to subsoiling and even development of machines such as the 'shakerator' which 'batters the soil into submission'.

It is essential to carry out preliminary work to break up the plough pan especially in the worst cases before the direct drilling system can be properly executed. In addition the amount of trash on the soil surface will almost certainly have to be reduced somewhat, though it is essential to maintain some cover.

The alternative to this former ill treatment of soils are tined implements which simply open up the crop rows. Thus effectively one is only disturbing a small proportion of the soil but the effect of pulling a tined implement at depth through the soil helps to improve the porosity and enable the microorganisms to act more efficiently. Where soils are damaged severely a remedial action such as subsoiling will be necessary before this equipment can be effectively used. What farmers have to appreciate is that although the work done is not as obvious as with disc ploughing, where the movement of the soil can be easily seen, the amount of tractor power required is similar in pulling the tines through the soil. This is a psychological factor that needs to be overcome through extension.

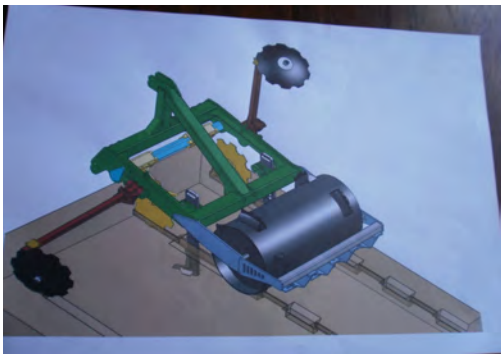
2. The Kenya small farmer's access to CA equipment

In the County of Yorkshire in England, a manufacturer of farm equipment has for a number of years been producing conservation farming equipment including direct seeders. Some of their large scale equipment has already been successfully introduced onto large farms in Kenya. A UK farmer who appreciates their benefits, having retired and handed over to his son, has now teamed up with some of the large scale farmers in Kenya in an attempt to introduce a specially adapted small scale version for using with the most common tractors.

Although there are some planters already on the market, this machine is very simple in providing minimum disturbance to the soil yet breaking through the pan and making fracture lines in the soil for moisture infiltration and improved plant root development. A two row machine with a disc opener to break through the surface layer of trash followed by a narrow tine which although it 'lifts' the soil is counteracted by a heavy roller on the back to minimize soil disturbance. The roller is fitted with flanges which are spaced so as to cause indentations in the soil into which the seed may be hand placed.

The Sumo 2 row planter

Rows 90cm apart, 25cm within row



The planting holes are set for maize – the main smallholder crop

This machine was first tried in 2010 in the Mara and Ngorengore and then more extensively in 2011 and 2012 again in the Mara, at Kiboko and in Eldoret and Kitale. The most successful crop was in the Mara and the farmer involved was prepared to use it again in the following season. He was unwilling however to pay the going rate equivalent to the cost of disc ploughing. This again highlights that principal difficulty of changing the mindset: the power used in opening the soil at depth to produce two lines for the crop rows is equivalent to that of ploughing. However the results are not as 'spectacular' on the eye as that of total soil inversion as is the case with disc or mouldboard ploughs.

Ngorengore, Kenya – November 2011

National Ploughing Final U.K. – September 2011

Another difficulty in promoting C.A. is in demonstrating that crop yields usually improve over time. It may take several seasons before this fact becomes apparent to farmers. It is also important to realise that in order to justify improvements in one part of the crop production that all the other inputs must be optimum to go from a really base level of crop yield to the sort of yields that large farmers are able to obtain, which may be up to five times or more the average.

A holistic approach is necessary rather than a marginal gain by only improving the cultivation which has been the practice in some other C.A. ventures.

Very often CA practice is farmer led. Such an example is the British immigrant farmer to Brazil, John Landers OBE, who is one of the founding fathers in that Country where over 25 million ha are now under some form of CA. He is a regular contributor to a magazine 'Direto no Cerrado' which is published in that Country. (www.apdc.org.br)

Planter at Shimo ltd, Mara river Nov 2011

Good penetration in the crop row

Compare that to Kenya where the figure is something like 33,000ha. In fact it is estimated that in the South American Countries of Brazil, Argentina and Paraguay about 70% of arable land is under some form of CA compared to less than 0.5% in Africa. This has taken about 40 years to achieve but there is no reason why similar progress should not be possible in Africa.

The work described here has been carried out so far by farmers with the support of some willing entrepreneurs which has required a considerable input in terms of finance and time. It now requires the wider community to provide finance and for research and extension officers to take on board the need for such technology and to assist with persuading farmers the necessity of adopting CA practices. As a Malawi colleague remarked to me: 'the plough was imported into Africa from western Countries and now you are telling us that we should stop using it!'

3. Conclusions

An example of an economic alternative to the disc plough/disc harrow system which is common throughout much of the African continent has been described. The difficulty of persuading farmer that it is a viable system has been highlighted partly because of the long term nature of the benefits to become apparent. Perhaps this may be easier to demonstrate in environments where more damage to the soil has already been the case, such as in some of the more eroded areas in Kenya or in South Malawi with pronounced decline in soil fertility.

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SUGARCANE AT UMFOLOZI, SOUTH AFRICA: CONTRIBUTING TO THE SUSTAINABILITY OF AN ENVIRONMENTALLY AND SOCIALLY SENSITIVE AREA

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Abstract

Sugarcane has been grown on the Umfolozi Flats in KwaZulu-Natal, South Africa since 1911 and now occupies an area of approximately 9 000 ha between the Umfolozi and the Msunduzi rivers. The sugar production area is bounded by a large local population and the iSimangaliso Wetland Park, a World Heritage site. This paper considers the value of sustainable sugarcane farming in an environmentally sensitive area with a large rural population. The Umfolozi Flats are eminently suited to sugarcane production due to its deep fertile soils, high heat units and favourable annual rainfall. With a labour intensive milling operation and manual planting and harvesting, job creation is considerable, providing direct employment for 6 000 people and in this way the sugar industry contributes significantly to the local economy. The location of the sugar mill in the midst of the production area, coupled with the utilization of a narrow gauge railway results in a highly efficient transport system with a minimal carbon footprint. Current sugarcane industry research focuses on improving efficiencies in the use of chemical inputs, including fertilisers and herbicides, thereby minimising contamination of the environment. A sustainable farming tool, the Sugarcane Sustainable Farm Management System (SUSFARMS®), which aims to guide growers on critical production, environmental sustainability and social issues is currently being introduced.

Keywords: sugarcane, sustainability, environment, South Africa

1. Introduction

An expanding rural population, a World Heritage Site and a productive agricultural industry are neighbours; neither one can survive without the effective management of the other. What role does sugarcane production play at Umfolozi?

There is an increasing global demand for sugar, on average 2% per year (Illovo sugar 2011) (fig. 1). Umfolozi is one of the most productive sugarcane growing areas in South Africa under largely rainfed conditions, with sugarcane yields often in excess of 140 t/ha and average yields of 93 t/ha being obtained on a twelve month cutting cycle. The St Lucia Sugar Company was established in 1916 with the construction of the first sugar mill. After major flooding it was purchased by Umfolozi Cooperative Sugar Planters (UCOSP) in 1923, then just a small group of pioneer farmers. The Mill to this day is owned by the majority of the growers who include 2800 small scale farmers from the surrounding communal areas.

The Umfolozi Flats, which supply 65% of the sugarcane to the mill, covers approximately 20 000 ha of which 9 400 ha is planted to sugarcane. The Flats are relatively flat stretching 30 km from west to east, with an average width of 7 km. There is a large rural population surrounding

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Figure 1. Global sugar demand trend

the farming area, while the iSimangaliso wetland park, a World Heritage Site of which St Lucia estuary is a part, lies to the north east.

Periodic flooding is a constant threat to farming operations. In 1984 Cyclone Demoina struck the east coast of southern Africa and caused wide spread damage, including the decimation of 1 800 ha of sugarcane at Umfolozi, which has never been re-established. Following a study commissioned by UCOSP a model was developed to simulate future flooding scenarios leading to an active flood defence system being implemented in 1986 (Bosch & Ass. 1986).

During the 1950's the St Lucia conservation authority took a strategic decision to separate the Umfolozi River from the St Lucia system due to concerns of high silt loads being carried down the Umfolozi River as a result of the deteriorating catchment. The conservation authorities adopted a strategy to continually keep the St Lucia mouth open with the construction of piers and mechanical dredging using the dredged spoil to create a sandbank preventing the Umfolozi River from entering the St Lucia lake system. iSimangaliso, the managing authority of the wetland park, initiated an investigation through a Global Environmental Facility (GEF) project to assess the effect of the Umfolozi River silt loads entering the St Lucia system with the conclusion that it was recommended to reverse the prior strategy and reconnect the Umfolozi River with the St Lucia system.

In the past ten years the area surrounding the Umfolozi Flats has seen a 20% growth in the rural population increasing the threat to the natural environment. With high unemployment (39%), subsistence farming with cash crops and vegetables is vital to the alleviation of poverty, often with detrimental impacts on the natural resources. With the average household of 4.9 people reliant on each breadwinner, employment is essential for the sustainability of the population and the survival of the ecosystems critical to the area (SA Census 2012).

2. Location

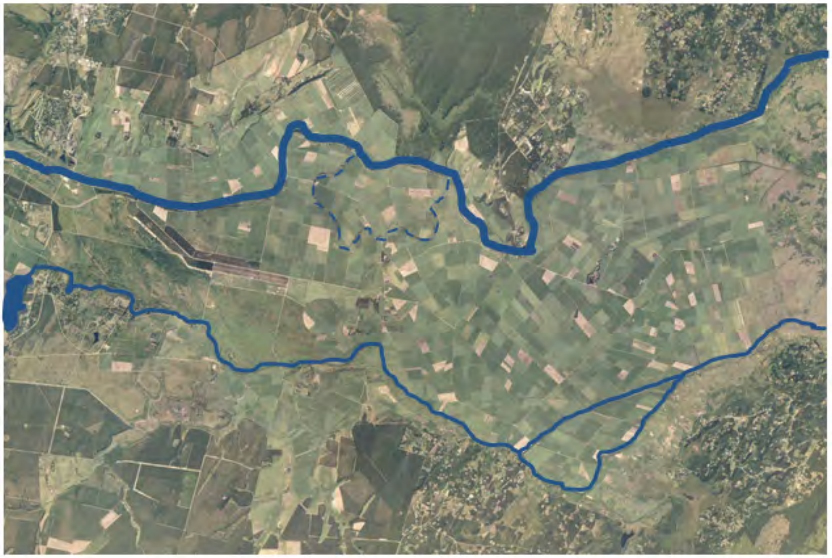

Figure 2. Umfolozi Flats showing Umfolozi River (North) and the Msunduzi River (South)

Figure 3. Location of Umfolozi in the South African Sugar industry

3. Climate

Umfolozi lies at 28° South 32° East on the eastern coastal belt of South Africa (Fig 2 and Fig 3). The average annual rainfall for the last 15 years has been 917 mm with a long term average of 1071 mm (manual measurements taken since 1957). Sugarcane requires 850 mm – 1 500 mm of rainfall in a cycle (Smith 2006).

Umfolozi's ground water table is generally high with deep, healthy, alluvial soils. Rooting depth in excess of 1000 mm, with Total Available Moisture (TAM) on most soils of 120 mm/m or higher. Supplementary irrigation is practised in the lower rainfall area during the high vegetative growth periods of sugarcane. Due to frequent coastal cloud cover, sub-optimal solar radiation is common, averaging 5730 Mj/m_2 per annum or 15.7 MJ/m_2 per day (SASRI weatherweb), optimal crop requirements are 6350 Mj/m_2 (Ramanujam & Venkataramana, 1999).

Data from the local weather stations give an average maximum temperature of 27°C and average minimum of 16°C. Sugarcane generally stops growing in the winter months when daytime temperatures remain below 16°C. (Smit, Singels 2007) At Umfolozi, therefore, there is generally active growth of sugarcane all year.

4. Demographics

There are 6 000 people directly employed by the Umfolozi sugar industry, on average one person for every four hectares of sugarcane (SA Cane Growers, 2012) and the mill employing 270 permanent staff. The 2012 census figures indicate that 29 400 people are directly supported by the Umfolozi sugar industry. In addition there are a large number of supporting industries which have established themselves in the area servicing the sugarcane farming and milling operations.

In the case of the small scale grower, most households have no income from off-farm business activities or employment and sugarcane is perceived as the greatest contributor to income (88%) (Cockburn 2012). A number of development projects are being carried out under the stewardship of Umfolozi Sugar Mill (USM), hoping to increase the number of small scale growers and to facilitate their sustainability. A number of individual growers also participate independently in projects aiding the upliftment of the rural communities.

5. Flooding and water management

The Estuary and the sugarcane growing area are intricately connected in terms of natural resources. The Umfolozi River is the biggest in the five catchments feeding into the estuarine system. With human alterations to the ecosystem and significant weather events, a number of management interventions have been required over the past 60 years. These have had some major effects on the St Lucia estuary (Zaloumis 2011).

Farming at Umfolozi requires consideration of flood water management. A system of major drains has been put in place as part of the flood defence system which accommodates flood waters in a scenario where they would overwhelm the river banks (Fig 4). Eighty per cent of the flood waters are diverted into a sand trap which prevents further sedimentation but allows flood waters to re-enter the lake system or go out to sea. The current flood infrastructure is designed to manage a flood of approximately 10 000 m^3/s. Of this amount of water only 1 200 m^3/s is contained within the levees of the river while the remainder of water is flooded onto the floodplain (Bosch & Assoc. 1986).

With peak rainfall occurring in the summer months between November and February, consideration has to be made of water volumes in excess of crop requirement, equally in the dry winter

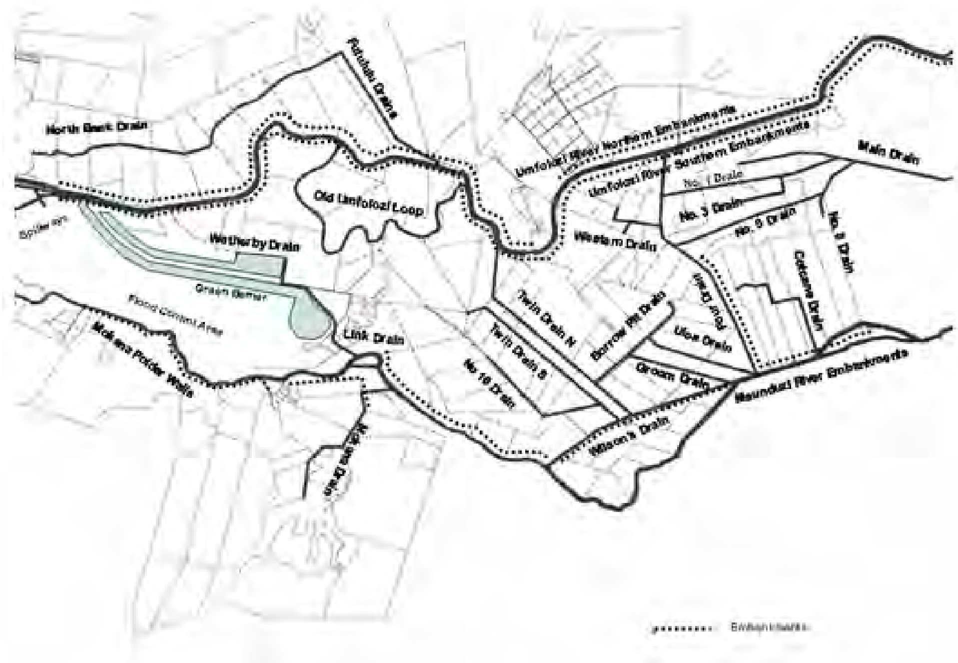

Figure 4. Map of the Drainage system used to manage flood waters at Umfolozi

months, water availability can be below crop requirement. The sugarcane harvesting season extends from April to December and most of the crop is removed from the fields during the dry months, minimising the compaction effects of loading and hauling operations. Sugarcane quality is also at its highest with the least impurities during the dry season.

In September, the sugarcane plant commences rapid growth with the rise in temperature and solar radiation; however, water supply can be a limiting factor. Umfolozi growers are often at the mercy of the weather, with only 30% having access to irrigation. Water storage capacity is limited; therefore irrigation water abstraction is directly out of the Umfolozi River. Each farm has a water use allocation right which is based on the capacity of the river in consideration of other water users. The Umfolozi River is often dry in the winter and spring months therefore water for irrigation is unavailable.

Prior to 2012 the mouth of the Umfolozi and the mouth of Lake St Lucia were separated, with the waters of the Umfolozi largely going out to sea when water levels were high enough to allow breaching of the river mouth. During times when the Umfolozi River mouth was closed, major agricultural problems were experienced with large water volumes backing up the system and flooding farms in the flood plain. Due to severe drought conditions in the past ten years, low water volumes were received from the catchment and the St Lucia Mouth remained closed. Water levels in Lake St Lucia dropped and estuarine function diminished to a critical point.

In 2012 the iSimangaliso wetland authority opened the mouth of the Umfolozi and Lake St Lucia once again forming a single estuary. High rainfall in the latter part of 2012 saw all five catchments contribute to the lake system and as a result Lake St Lucia is currently in a much healthier state. On-going studies funded by iSimangaliso's GEF have enabled investigations to fully re-establish estuarine function.

6. Nutrition

Sugarcane requires appreciable inputs of N and K for optimum yields. Assimilation of N into dry matter is, however, highly efficient relative to commonly propagated forage grasses (fig. 5).

On the Umfolozi flats much of the N requirement of cane is applied as ammonia gas injected into the soil to a depth of approximately 200 mm. Granular fertilisers are often applied using machinery that incorporates the product 200 mm plus below the surface. These application methods are designed to minimize volatilization losses of N, while deep rooting systems of the crop mean leaching losses of N are also restricted. Much of the crop's nutrient requirements are applied in a split application, assisting the plant in improving its utilization efficiency and also in reducing leaching or de-nitrification.

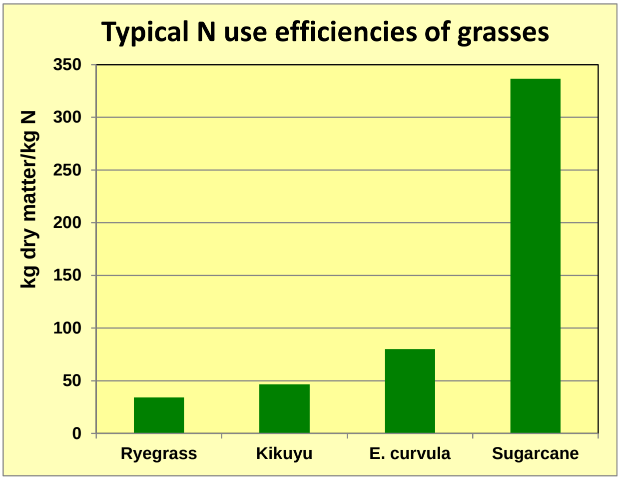

Figure 5. Nitrogen use efficiencies of grasses

7. Pests and disease

There are a number of pests associated with sugarcane production in South Africa; Management practices of the Umfolozi growers have adapted to accommodate such pests. *Eldana saccharina* Walker (Lepidoptera: Pyralidae), one such pest migrating from sedges into sugarcane, caused the reduction in cutting age from 18 months to 12 months. The South African Sugarcane Research institute (SASRI) has a plant breeding programme that has produced numerous pest and disease resistant sugarcane varieties, many of which have been planted at Umfolozi. This has contributed to the limited use of pesticides to control Eldana. As a continuation of this approach, an integrated pest management (IPM) system is currently being introduced. This approach focuses on revitalising the natural habitat of Eldana and the planting of Molasses grass *(Melinis minutiflora)* as a repellent in a so-called "push pull system" (Cockburn 2012), thus attracting the Eldana back to its natural habitat while repelling it from the sugarcane fields. Natural predators of Eldana will be given a chance to build up and in this way a natural management of Eldana levels will be encouraged with minimal environmental effects.

In 2005 sugarcane Thrip (*Fulmekiola serrata*) was first identified in the South African industry. Since then much research has been dedicated to quantifying damage and controlling this pest. Imidacloprid was registered for the control of thrip in sugarcane in 2009. Commonly used as an "in furrow" application at planting, Imidacloprid is being discouraged as a foliar application due to the negative effects on non-target species. This is the only chemical commonly applied at Umfolozi during the target times when high Thrip numbers occur in 2 to 6 month old sugarcane.

Some soils at Umfolozi have clay content of below 15% and as such are prone to nematode damage. Aldicarb, a nematicide, has recently been de-registered and is now an illegal product in South Africa. The prior minimal use of nematicides has been further reduced due to the lack of a comparable product.

The sugarcane industry has been subjected to some serious fungal infections. There are some rust species common to the local industry; few have been of major economic significance. Sugarcane smut has historically had a major impact. Smut-resistant varieties are produced in SASRI's plant breeding programme, and those varieties which demonstrate susceptibility post-release, have generally been removed from the industry or restricted to low risk areas.

Each Mill area in the sugarcane industry has a Pest, Disease and Variety control service, comprising a team of field inspectors who carry out farm inspections daily for pest and disease risks. Their findings are reported both locally and to SASRI where any concerns are immediately acted upon. Umfolozi has maintained a low risk profile with attention paid to variety choice and to rogueing of high risk smut-infested fields. Fungicides are registered for use in the sugarcane industry; however Umfolozi has little use for these with rust levels being below economic thresholds.

Undeveloped lands at Umfolozi, mainly the flood damaged areas from Cyclone Demoina are often subject to conditions which enhance alien plant encroachment. Work is underway to control alien plant species in these areas. Despite being unproductive, these areas of land are of high importance in flood management. The release of *Anthonomus santacruzi,* – a weevil for the control of *Solanum mauritianum* an invasive plant species from South America – is an example of the control methods being used.

8. Husbandry and harvesting

The South African Sugar Industry is very labour intensive. Sugarcane on the Umfolozi flats is harvested exclusively by hand requiring a large amount of seasonal labour. Many of the day to day farming activities such as fertilising and weed control are also done manually and much of this labour requirement is drawn from local communities.

9. Transport

Umfolozi is the only sugarcane growing area in Africa to still use narrow gauge rail to transport the raw product from the field to the mill. One locomotive hauls 400 tons in contrast to a road haulage system, hauling approximately 32 tons on the same lead distance. An equivalent road haulage operation would contribute 1 555 tons of CO_2 in a given season compared to 725 tons CO_2 for the same season using the narrow gauge rail system (Buckley, 2013). This represents a 53% decrease based on fuel usage alone (Fig. 6).

Furthermore the loading operation partnered with the narrow gauge rail system has a low impact in the field with maximum axle weights below 7 tons when moving the cane from the field to the siding. This leads to low compaction and reduced damage to the soil structure.

Sugarcane is planted on a 7-10 year cycle in South Africa, thus benefiting from very few tillage operations during the life of the crop resulting in less damage to the soil structure. Due to favourable growing conditions on the Umfolozi flats, the industry average of a 7-10 year cycle is often increased to over 12 years. Minimal disturbance of soil when growing sugarcane and the naturally flat topography at Umfolozi means that there is very little soil erosion from the sugar farming area.

Figure 6. The Narrow gauge locomotive hauling trucks of sugarcane to the Umfolozi mill

10. Milling

The milling operation at Umfolozi recycles the water from the sugarcane stalk for the refining process; very little water is used from the river system. No cane is washed prior to entering the milling process, although cane does go over a slotted pan to allow sand and other foreign matter to fall through. There are by-products from the milling process: molasses, from which alcohol is distilled, and bagasse, used to fire the boilers for the milling process and to co-generate electricity. Effluent from the milling process is pumped into settling dams situated far from natural water courses or riparian areas, in compliance with government legislation. The effluent, made up mostly of organic matter is left to break down in the dams and is sometimes used as an organic fertiliser on the sugarcane fields replacing micro nutrients, organic matter and soil carbon.

11. SUSFARMS®

There is pressure on sugarcane producers and the sugar industry for more sustainable production schemes that can help promote best management practices (BMPs) and ensure desirable development conditions for communities and the environment (UNDP, 2010).

SASRI has developed the Sustainable Sugarcane Farm Management System “SUSFARMS®” (Maher 2007) as a means to measure and educate sugarcane producers on BMP’s. Based on three main principles; economic, social and environmental, SUSFARMS® places significant emphasis on fair labour practices (in accordance with the various Acts) and addresses various community development and environmental issues. While SUSFARMS® provides a platform for sugarcane growers to gauge their farming impacts on the community and environment; it also provides measures for ensuring increased profitability and sustainability.

As part of SUSFARMS®, growers are required to take regular soil and sugarcane leaf samples, and send them to an analytical laboratory such as the one at the SASRI for analysis. Here, based on test results, fertiliser recommendations are made relating to the optimum and sustainable growth of the sugarcane crop. This helps to ensure that the farmer’s operation is sustainable, that crop requirements are met and wastage of products that could potentially contaminate the local environment is prevented. Growers are required to keep accurate records of agricultural chemicals applied to their fields.

Similarly, it is expected that growers undertake to regularly remove alien plant species and also, where possible, to protect indigenous species and encourage the movement of wildlife through the establishment and maintenance of ‘protected wildlife corridors’.

12. Concluding remarks

The Umfolozi sugar farming and milling operations have sustained the local communities for 100 years, becoming vital to the economic and social wellbeing of the area. There is little doubt that the potential unemployment rate, already at 39% locally, would be exacerbated in the absence of the local sugarcane industry. The exposure of flora and fauna in the iSimangaliso wetland park to the negative effects of an impoverished local community would be extreme, as experienced in many other parts of Africa.

With small scale grower operations being expanded, there will be increased demand for manual labour and thereby the further enhancement of the socio-economic contributions of sugarcane operations to communities.

Although in a relatively sensitive area from an environmental perspective, sugarcane growing and milling operations are carried out with an appreciation of the surrounding environment with minimal negative impacts on the natural resources in the area. The introduction of management tools, such as the Sustainable Sugarcane Farm Management System initiative, will increase awareness of environmental factors and is likely to further improve the relationship between agriculture, local communities and the natural asset of the iSimangaliso wetland park.

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POLES APART: MANAGEMENT CONTRIBUTIONS, LESSONS AND ASPIRATIONS OF POLES AND OTHER EAST EUROPEANS WORKING IN UK AGRICULTURE

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Abstract

Dramatic political changes in Poland and elsewhere in Eastern Europe during the 1980s, culminated in collapse of the Berlin Wall in November 1989. Following this, and EU accession in 2004, new opportunities opened for Poles and other East European citizens to work in UK Agriculture, and to experience entrepreneurship. Apparently, many were attracted initially by superior wages attainable through diligent hard work on British farms. Migrant labour, largely of East European origin, now accounts for almost 90% of the workforce engaged in fieldwork involved in field-scale vegetables, and a majority of dairy milkers and managers, particularly from Poland. In conjunction with research within the CEEC Agri-Policy Project, this paper seeks to contextualise focus research findings among a sample of expatriate Poles and others from Eastern Europe now working within UK Agriculture. Cohorts from within English field-scale horticulture and in the UK dairy sector were to be included. The dairy sector declined to respond, and the field-scale crop sector response was small. Coincidence of wide UK media coverage on immigrants working in the UK may have led some to fear a political agenda for this research rather than its purely managerial interest - on management contributions being given on UK farms, lessons being learned and aspirations for future work. Especially of interest is whether or not Poles intend to return to share their management experience for the benefit of Poland, in the context of projected rural depopulation and current agricultural land use trends there.

Keywords: management, lessons, aspirations, migration, change, enterprise

1. Introduction: the context of migration from Eastern Europe to the UK

This paper defines a migrant as per Green *et al* (2005) 'a person from outside the UK who has moved to the UK primarily for employment purposes'. Migration into the UK to work has been considerable. According to Wilson *et al* (2005) those of white ethnic origin predominate, rising from 21,343 in 1994 (94.6% of all migrants) to 23,232 in 2004 (91.0% of all migrants). In late 2012, the total number of non-UK-born people in employment in the UK was 4.27 million, up 208,000 from a year earlier (ONS, UK Government, Labour Market Statistics, November 2012). Migrant workers may obtain visas through the Seasonal Agricultural Workers Scheme (SAWS), which in 2004 provided permits to 25,000 agricultural (including pack-house) casual and seasonal workers. The Association of Labour Providers supplies some 400,000 workers to agricultural and fresh produce trades, of whom most are from outside the UK. Increasing globalisation coupled with downward pressure on farmgate prices by supermarkets has led UK farmers to seek a more flexible and cheaper workforce, with consequent decline in permanent full-time workers and an increase in casual and seasonal labourers. Upheaval in global population movement is predicted to continue towards 2050, not only with an ongoing influx of African and Asian migrants into Europe but also with population

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decline in countries like Bulgaria and Poland – forecast at, respectively, some 35% and 20% drop (Wibberley, Turner, 2008). Many Poles will likely continue to enter Britain for work, and potentially more Bulgarians (up to 75% of whom currently work in their own agriculture) and Romanians after full EU freedom of movement for those two nations for employment from 2014.

The majority of Eastern European countries are still facing the challenges of marketisation and democratisation post-communism. Haughton (2005) notes (p.104) “Unemployment was one of the most visible indicators of those who lost out. The market introduced unemployment where it was (nominally at least) non-existent.” Of the eight CEE States (the so-called A8) of Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia that joined the EU in 2004, only Hungary and Poland were not previously part of communist era federations. In all communist countries, people had been educated as communists and socialised into a context where the market, private property and civil society were largely absent. Although Specialist Farm Production Associations are important in Lithuania (e.g. The Mushroom Growers’ & Processors’ Association) nevertheless regional groups are hindered by lack of good leadership and management in a context cited as being characterised by “people’s reciprocal distrust”. Poland reported a general lack of rural motivation to learn. However, Poland has many Agricultural Chambers and Circles for mutual practical learning, such as those of rural housewives and its extensive Rural Youth Union (Turner, Wibberley, 2007). Furthermore, Poland has considerable inward investment from visionary firms like Greens of Soham, Cambridgeshire, England via their *Spearhead International* business since 1995 that now (as the largest farming company in Poland) farms around 30,000 cropped hectares in Poland, largely on 30-year land lease contracts (www.spearheadgroup.co.uk).

2. Essential contrasts

The central issue of this paper is the concomitant irony that:-

- Poles are migrating to serve UK agriculture within its context of expanding rural population and a historically progressive agricultural management culture, while
- Poland’s rural areas with their largely fertile soils face substantially declining populations coupled with their challenge to sustainably transform farm management.

The key hypotheses are that:

- Improved agricultural management is crucial, and lessons positive and negative learned in the UK about it might reasonably be expected to help Poles to help Poland;
- That a ‘brain drain’ of motivated and trained Polish agriculturalists would thus appear to be needed returning to Poland, leading to the question:
- Do they so aspire to return to Poland, or are they keen to settle long term in the UK?

In the UK in 2013, the matter of immigrant workers has become a controversial political matter with its potential displacement of jobs for British citizens, plus the possibility of migrants claiming UK social benefits after working in the UK for only 12 months. Against such public concerns is the fact that a large majority of migrants, especially from Poland, have a reputation within UK agriculture for reliability, hard work and willingness to tackle tasks deemed too dangerous, dirty, demanding or demeaning by many UK nationals. Meanwhile, Poland faces a projected population decline of around 20% by 2050, more so in its rural areas.

3. The particular case of Polish immigration to UK agriculture

What might be motivating Poles to enter the UK for agricultural and other work? Wrzochalska (2007) noted that the rural population represents about 38% of Poland's 38 million inhabitants, with increased unemployment especially among persons connected with small (2-5 ha) and medium (5-10 ha) farms. Almost half of Poland's 312 km² of land (over a quarter bigger than the UK) is fertile, and the country is 34% arable, 8.4% grassland, 29% afforested. Land prices in Poland have risen inexorably since 2000 and unemployment is officially at 12.3% with significant hidden rural unemployment (Skrztipex, 2013). Of Poland's 2.5 million farms, only 25,000 exceed 50 hectares in size, and average farm size is 10.23ha. Surveys carried out by the Institute of Agricultural and Food Economics (IAFE) in the years 2000-2005 showed the scale of hidden unemployment in agriculture (Wrzochalska, 2007). She asserts that in this situation, the problem of how to better deal with labour surpluses occurring in the countryside can only be solved by taking into consideration their employment on a part-time basis. The number of farms running off-agricultural business activity increased from 249,000 in 1996 to 363,400 in 2002, i.e. by 46.0%. She also noted the considerable regional variation in employment in agriculture, for example from 9.0% of the workforce in Silesia Province to 39.5% in Podlaskie Province. Polish agriculture does receive encouragement within the economy. Some Scientific Research Institutes provide specific training and advice to farmers and Poland maintained some 4500 staff giving free advice within its National Agricultural Extension Service; however, some farmers have to travel great distances to reach official agricultural extension centres in the large territory of Poland (Wibberley, Turner, 2008).

According to the 2011 UK National Census, some 521,000 Polish-born people live in Britain, seven times the number listed a decade earlier. Poland is the most common country of birth for non-UK born mothers in Britain, with 20,495 babies born to Polish mothers in 2011 (Rainey, 2013). Poland's accession to the EU in 2004 gave a huge stimulus for immigration to the UK, with borders open for free movement of Poles for employment there, where they can expect to at least double their hourly wages. Between 2004-06, the Office of National Statistics recorded 264,560 Polish migrants to Britain. In 2011, 45,000 Poles settled in the UK, marking the biggest annual rise in Polish migrants since the financial crash of 2008.

Historic reasons for the particular affinity between Poles and the UK may be as follows:

- Second World War Polish community that fled communism and came into the UK;
- War effort contributions of Poles: troops, intelligence, equipment (Rainey, 2013);
- After France fell in 1940, the exiled Polish government went to London, plus 20,000 Polish soldiers and airmen;
- Poles made up the largest non-British group in the RAF during the Battle of Britain;
- By July 1945, over 150,000 Polish troops served under British Army command;
- After World War II, British PM Sir Winston Churchill vowed the British would 'never forget the debt they owe to the Polish' and pledged 'citizenship and freedom of the British Empire' for all Poles, many then fleeing communism in Poland;
- The UK Government passed the Polish Resettlement Act 1947, the UK's first mass immigration law;
- The critical mass of Poles within Britain thus established sustained specialist shops for Polish groceries and cuisine, providing a receptive group for subsequent migrants;
- Poles retain their national pride so, accordingly, most work flexibly hard in the UK;
- There seems to be ongoing kindness towards Poles in Britain, perhaps due to history;
- Boston, Lincolnshire, England, has 3,006 Poles out of 62,243 residents (almost 5%).

The mutual relationship is not always smooth, of course. There are employers in UK agriculture against whom charges have been pressed for negligent health and safety at work or else inadequate housing provision for migrants. However, the efforts of Zad Padda (2006); McKay *et al* (2006), rural churches migrant ministries, and the GLA (2011) help to ensure greater responsibility among gang-masters recruiting migrant field workers for UK crops. Against the general trend also, not all Poles in the UK behave well either; there are currently more than 700 Polish migrants in UK prisons. Also, of the 371,000 non-UK nationals currently claiming unemployment benefit, 13,940 are Polish (Rainey, 2013). Overall, there seems to be a future for Poles wishing to settle into British Society long-term, and also a welcome for younger Poles wishing to experience adventure, perhaps gain agricultural management skills and then return to serve Polish agriculture at the heart of Poland's rural economy.

4. The research focus group

At the outset of the present research, it was the intention to harvest a sample of opinions and data predominantly from Polish migrants working in UK Agriculture (but also including other Eastern European migrants). It was hoped to have at least 25 respondents (ideally 50) in each of two cohorts of a) Field Crop workers/managers; b) Dairying workers/managers. Accordingly, easy-fill questionnaires were issued by the author via appropriate contacts within UK Agriculture during October 2012 asking for electronic and, if preferred, anonymous return within two months i.e. by late December 2012. This was to be in time for proper analysis by the author, who is fully occupied within agriculture and rural work in the UK and overseas, with neither time nor resources to fund research *per se*. Despite good contacts and previously high rates of response to many surveys conducted by the author in agriculture internationally over the years, eventual response to this has been very disappointing (thirteen on field crops), and one in the case of dairying although thrice re-issued with revised dates for submission (mid-January 2013; mid-February; mid-March). Why? Maybe those asked were too busy at the time. However, it seems a core reason may be fear, despite efforts to assure potential respondents that this is purely an agricultural management enquiry:

- Fear on the part of some employers that this information might somehow lead to more of the dreaded bureaucratic intrusion that bugs EU/UK agriculture;
- Fear perhaps from some employers that these data might reveal inequities in treatment of migrant workers;
- Fear by some migrants that their answers may be open to misinterpretation by employers, and risk job security for migrants unless compliant with 'expectations';
- Fear by migrants that information given might inflame already edgy immigration politics in the current UK media;
- Fear that data from such research might help (albeit in a small way) to clarify the maybe conveniently opaque UK statistics/data regarding migrants at work in the UK.

Respondents were sought all over England. Those who replied were 3 from Herefordshire in the West and 9 located in England's fastest growing Eastern region in terms of population (projected to rise by around 19.5% between 2010 and 2030), specifically with one esteemed employer in Cambridgeshire. Eastern England has a high concentration of fertile arable and, in particular, field-scale vegetable growing land. It has been the location of previous studies on migrant labour. For example, in Norfolk, it is noted that there is insufficient local labour willing to work in agriculture, food processing and packing industries; hence migrants play a vital role in the local economy. In Norfolk there is a multi-agency migrant support group, co-ordinated from Norfolk County Council (McKay, Erel, 2004; McKay, Winkleman-Greed, 2005).

At the time of writing, ahead of the IFMA 19 Paper submission deadline of March 31st 2013, only a cohort of 9 male field crop migrant employees from a highly respected Cambridgeshire farming business responded (Shropshires, Ely: www.gs-fresh.com). These were all males aged from 27 to 35 (average 31). Their origins were:- 3 Poles, 3 Bulgarians, 2 Lithuanians, 1 Ukrainian. All are in managerial roles – from General Manager UK Harvest Operations employing 900 people, to Site Supervisors and those responsible for delivery of particular crops from field to customers. Hence, their responses are both highly informed and very relevant to the interest of this paper. Their management responsibilities involved personnel, policy and harvest production. Bearing in mind the small size of this sample, Tables 1, 2 and 3 record the mean and range of results on, respectively, Management Lessons being Learned (Table 1), Personal Skills being Developed (Table 2) and Preferred Future Job Aspiration in 5 years' time – including whether they wish to return to their own nations to use their acquired skills and experience (Table 3).

Table 1. Management Lessons being Learned; % of respondents (n = 9)

Enterprise	55	Entrepreneurship	55
Decision-making	67	Risk-taking	78
Leadership	89	Teamwork	89
Line Management	44	Strategic Planning	89
Technical Husbandry	33	Marketing	67
IT & Computing Skills	55	Other	NR

Leadership, Teamwork and Strategic Planning lead the management learning for most.

Table 2. Ranked (1 = Very High, to 5 = Very Low) Personal Skills Developed (n = 9)

	Mean	Range
Confidence to embark on my own rural business back home	2.9	2 to 4
Competence to start my own business with relevant skills learned	2.7	2 to 4
Motivation to now return to my home country and be enterprising	2.9	2 to 4
Networking links with other professionals to help me Manage	2.8	2 to 4
Knowledge to equip me for future working life whatever I do	1.9	1 to 2

At the Cambridgeshire operation, respondents are clearly 'pretty happy with the organisation for which they work' and with 'all the skills and knowledge developed, with all training provided'. 'I keep learning every day and deal with different challenges'. Experience elsewhere is not always so conducive.

Table 3. Preferred (1st and 2nd choice) Job Aspirations in 5 Years' Time

	No.1st	No.2nd
a. Own rural business back home in my country of origin	1	1
b. Equivalent management job to my UK job now back home	-	-
c. Promotion in my UK job & stay in the UK	8	1
d. Retain my same UK job as at present	0	3
e. Move to another country and pioneer new farming work	0	1
f. Leave agriculture/horticulture to work in another sector	0	3
g. Other – please state what?:-	NR	NR

Almost all aspire to achieve promotion in their present jobs within the next five years and stay in UK agriculture, while one prefers to return home and start his own rural business. If such promotion did not arise, one third of the respondents second choice might be to leave agricultural work for another sector. Three subsequent replies from Herefordshire in April 2013 were from males (two Romanian and one Bulgarian) average age 31 (as for Table 1 Cambridgeshire cohort) who had spent 9 years working in the UK. All three wish to stay within their UK job with promotion in five years' time. If not, an equivalent job back home or a rural business back home or stay in the same UK job were their second choices.

Among the biggest surprises or shocks about living and working in the UK, the following were cited:- weather and language barrier; new technologies; work organisation; health & safety emphasis; level of wasted food, especially on the field; lack of understanding from the UK population about the agricultural sector and the difficulty [for farmers] of delivering the finished product; lack of interest by English people to work in agriculture (while many other nationalities work in the field, English people don't want such work).

Clearly, the Shropshire family's Cambridgeshire business is much appreciated by respondents, providing 'a fantastic opportunity to grow', inspiring allegiance among their migrant worker managers, achieving' year-on-year better results'.

5. Discussion

The sample of informants cited here may exclude some more experienced individuals who have already returned home to Poland, or moved on to other managerial level jobs in the UK. The broad statistics seem to suggest that many, perhaps most, migrant workers come for a period only – often intentionally short-term - during which they save, remit funds back home, gain experience and then return with a good basis (funds, plus experience and contacts) on which to build whatever their entrepreneurial inclinations suggest. It may be also that many of the migrants we see are among the more capable and dynamic of their peer group (a microcosm of this phenomenon occurred during the unification process of Germany, with poorer parts of the former East being left with the less able, the more able having gone to West Germany to seek better prospects). The single Polish dairyman respondent aged 29 had worked in Oxfordshire UK for 7 years taking responsibility for breeding policy with the cows and for personnel in the farm team, gaining substantial management experience. Despite gaining very high motivation to be able to return home and be enterprising, he aspires to stay in his present UK job or be promoted in it. He cited the reasons as 'a well-developed [UK] economy', that he feels 'part of the community' and had received in the UK 'a nice welcome'.

6. Conclusions

The reported exploration of this politically controversial yet intentionally constructive topic of migrant workers in UK agriculture originating from Eastern Europe suffered from limited baseline data. However, indicative information gleaned both from the migrant worker cohorts in Herefordshire (West of England) and in Cambridgeshire, Eastern England, from the literature and from other Eastern Europeans in the UK suggest that those given managerial responsibility here are likely to want to stay. The more altruistic motive to support the development of Polish agriculture does not appear as yet sufficiently weighted to attract significant numbers of such skilled migrants back to Eastern Europe.

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Appendix I. Survey Questionnaire

Management lessons learned & future plans of East Europeans now on UK crops

I am interested to know what benefits are being gained by those from Poland and other East European countries who are currently working in UK Agriculture & Horticulture, where their contribution to farm work is considerable. I will be much obliged if they will kindly answer the following questions **by February 15th 2013.** With thanks, Professor John Wibberley, UK.

1. Your Name (Optional)_______________;AGE___;GENDER:- Male __ or Female__;

2. Country of Origin/Nation of Birth?_____________; No. of years working in UK?___;
   In which County in UK do you work now?___________________;

3. **Present Job title**? ____;

4. Please TICK (√) which of the **Management responsibilities** you have for crops:-

   Nursery____; Fertilising _____; Spraying ______; Policy________; Personnel ______;
   Other?:
5. Please TICK (√) what **Management Lessons** are you learning of use for future work?:
   Enterprise ____; Entrepreneurship ___; Decision-making ___; Risk-taking ___; Leadership___;
   Teamwork ____; Line management ____; Strategic Planning ___; Technical husbandry _____;
   Marketing _______; IT & Computing skills _______; Other (please state:- _______________
   ____).

6. Please RANK on 1 to 5 scale (1=Very High;2 =High;3 =Average; 4 =Low; 5 =V.Low)
   g) **Confidence** to embark on my own rural business back in my home country ____;
   h) **Competence** to now start my own business with relevant skills learned ____;
   i) **Motivation** to now return to my home country and be enterprising ____;
   j) **Networking** links with other professionals to help me as a Manager in farming ____;
   k) **Knowledge** to equip me for future working life whatever I choose to do _____.

7. What is your preferred 1st choice (1) & 2nd choice (2) **Job aspiration** in 5 years time?:-

A. OWN RURAL BUSINESS BACK HOME IN MY COUNTRY OF ORIGIN	
B. EQUIVALENT MANAGEMENT JOB TO MY UK JOB NOW BUT BACK HOME	
C. PROMOTION IN MY UK JOB & STAY IN THE UK	
D. RETAIN MY SAME UK JOB AS AT PRESENT	
E. MOVE TO ANOTHER COUNTRY AND PIONEER NEW FARMING WORK	
F. LEAVE AGRICULTURE/HORTICULTURE TO WORK IN ANOTHER SECTOR	
G. OTHER – PLEASE STATE WHAT?:-	

8. What have been the biggest surprises or shocks about living and working in the UK?
9. What other comments in relation to farm experience gained would you like to share?

Man thanks for taking time to complete/return survey to: **ejwibberley@btinternet.com**

III.
POSTERS

MAIZE PRODUCTIVITY AND RURAL POVERTY REDUCTION IN A LIBERALIZED FERTILIZER MARKET IN NIGERIA

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Abstract

Over the years agricultural productivity has been a major concern for agricultural policy because of its influence on development. An important share of total agricultural productivity growth has been attributed to increased use of fertilizers. Consequently, improvement in productivity is crucial in attaining growth in the Nigerian economy since agriculture provides a major means of livelihood for about 70 per cent of the population. Maize is one of the most important staple food crops grown in Nigeria. More than 70 per cent of fertilizers dedicated to cereals production in Nigeria are used for maize production. Fertilizer prices have generally risen over the years as a result of fertilizer market liberalization. This in itself may have unfavourable implications for agricultural productivity and rural poverty reduction. This study examines the effect of fertilizer market liberalization on the productivity of maize and rural poverty reduction in Nigeria, using Data Envelopment Analysis (DEA) Malmquist index. Data were collected from 1990-1996 (pre-liberalization period) and 1997-2006 (liberalization period). Results reveal an increase in total factor productivity (TFP) growth of 4.7 per cent during the pre-liberalization period as compared to a decline in total factor productivity (TFP) growth of 5.4 per cent during the liberalization period. This could be due to high fertilizer price owing to transportation cost, inadequate supply, artificial scarcity and inefficient fertilizer distribution system leading to a fall in fertilizer usage among smallholder farmers who produce most of the crops grown in Nigeria. Since there is a direct relationship between agricultural productivity growth and poverty reduction, this result implies that the decrease in maize total factor productivity during the liberalization period led to a decrease in earnings of farmers as well as less financial capital for investment, thus increasing rural poverty. This study in line with several other studies in sub-Saharan Africa countries has shown that fertilizer market liberalization has not stimulated increased crop yield, raised agricultural production or raised income of smallholder farmers. It is concluded that, the liberalization of the fertilizer market did not accomplish the benefits expected from the process. It appears that fertilizer market liberalization may not be appropriate for an economy that is dominated by millions of smallholder resource poor farmers. Consequently, improving access to fertilizer by re-introducing fertilizer subsidy targeted at smallholder resource poor farmers may not be out of place to enhance maize productivity in order to boost food security position, increase farmers' income and lighten poverty in rural households. An effective fertilizer distribution channel should be put in place to ensure that subsidized fertilizer gets to farmers as early as possible.

Keywords: maize, Malmquist index, total factor productivity, poverty, fertilizer, liberalization

THE VALUE OF BRANDING AS MANAGERIAL TOOL TO INCREASE FARM INCOME

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Abstract

Farming, as business activity, has been experiencing a cost-income plier effect for the past decade, resulting in pressure on the income whilst also suffering increased costs of production inputs. As a result, small-scale farmers depart from the industry, leaving farms in South Africa to grow in size to remain economically viable. Traditionally farmers in South Africa have been subjected to regulating boards such as the wheat and maize boards, regulating prices and dealing with marketing of produce whilst farmers efficiently managed the production inputs. However, these boards have dissolved, and a free-trade marketing environment now further taxes farm management with effective marketing of produce. Subsequently, farm net profits no longer requires only management of production inputs, but also requires selling produce at the best possible price to the open market (an area of expertise which is largely lacking). However, this marketing opportunity goes begging. Farmers largely fell into new grain, meat and other produce marketing channels, becoming market price takers once again and not increasing the value of their produce in the market.

One way to improve farm income is by adding value and combining the managerial tools of differentiation and then branding of farm produce. Differentiation (the way to have your products appear different from other similar products could be on a physical or on psychological level) and branding the product (thereby earning value through brand advantages) can lead to substantial increases in the prices fetched in the open market for farm produce. It is also important to note that branding can be successfully applied to industry levels, regional levels, specific cultivars or animal breeds (or even the colour of an animal breed), and also (contrary to common belief) on a farm level by a single farmer to increase his or her income. Market analysis and customer preferences are also keys to success in differentiation and branding exercises in commercialization.

Typical examples of successful differentiation and branding to improve farm income (as shown on the posters) are:

- *Angus Beef fetches 10% premium prices due to branding of Angus beef.*
- *Ayrshire milk fetches 20-25% price premium due to their branding as an elite milk.*
- *Bonsmara breed of cattle (South African cattle breed) fetching up to 25% premium on bulls sold to commercial cattle farmers.*
- *Pienaar sheep (a South African Merino stud sheep farmer) who now exports semen to Australia and New Zealand.*
- *Karan beef increased carcass prices in open market by branding their beef carcasses as "rounded off only on quality grain" in their feedlot.*
- *New Zealand lamb as grass/pasture grown lamb from a healthy environment.*

Reaping the benefits of differentiation and branding can be achieved by farmers in four steps:

1. *Examine the produce or products that is produced on the farm, district or region (consider also cultivar, animal breed and other distinguishable features).*
2. *Can a difference be identified from other similar products?*
3. *Is this difference important enough to take to the market and will the buyers pay a premium for it?*
4. *Brand the "difference" – give it a name to distinguish it in the market.*

Key words: differentiation, branding, farm income, cost-income plier effect, economic survival

EMBRACING OHIO'S NEW, BEGINNING, AND MINORITY FARMERS

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Abstract

The New and Small Farm College focuses on landowners seeking comprehensive farm ownership and management programming. Started in 2005, the program focuses on new, beginning, and minority farm landowners in Ohio seeking comprehensive farm ownership and management training. Curriculum developed by OSU Extension educators address a variety of educational objectives. Program objectives include improving the economic development of small family-owned farms in Ohio, helping small farm landowners and families diversify their opportunities into successful new enterprises and new markets, and improving agricultural literacy among small farm landowners not actively involved in agricultural production.

The educational components of the Small Farm College consist of the following eight session: 1) participants develop a mission statement and set goals for their farm business; 2) short interactive presentations from government, financial, and farm organizations that can provide further assistance following the college; 3) taxes, liability issues and insurance issues; 4) inventory of land resources including soil fertility, water, woodland, and wildlife; 5) business planning, farm records, loan requirements, and production record keeping; 6) row crop and horticulture production, budgeting, and organic certification (as identified by participants); 7) livestock production, budgeting, labor resources, and forages; and 8) developing markets, niches, pricing, and utilizing technology. The college consists of 20 hours of classroom time and a single-day tour of various small farms to demonstrate successful agricultural enterprises.

Pre/post-program surveys of 254 participants (mean age = 45.2 years) indicated a high level of post secondary education (72%) and computer literacy (85%). Underserved populations were recognized in that 38% of participants were female and 71% were new clientele for OSU Extension. The average farm size, for the participants, was 76 acres with 12.7 years average ownership.

While 53% did not initially have a plan for their farm and 47% either were actively farming or had some idea of the type of production they were planning, post-program surveys indicated 72% of the participants created or changed their farm use plan as a result of attending these colleges. The participants rated the overall program a 9.05 on a 10 point Likert scale with 10 being best. One hundred percent of all participants responding would recommend this program to others and 96% felt the program met or exceeded their expectations. One participant commented that the OSU Extension Farm College is very thorough and enthusiastically sets you to start working on what you want to do in your farm. He goes on to say that he loved the fact that, during every single session, the need for a plan was emphasized a necessary before you start working on your farm business.

Keywords: new farmer, beginning farmer, minority, education

RESPONSES TO FARM MANAGEMENT TECHNOLOGY TRANSFER SURVEY: PRELIMINARY RESULTS

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Abstract

Authors obtained permission for one-time access to IFMA membership email addresses for the purpose of announcing and requesting response to a 13 question electronic survey. The survey addressed the status, structure, and funding of technology transfer to farmers including government extension, private consulting, and others and the status of feedback of needs to researchers. Respondents represented university faculty, government employees, self-employed consultants/advisers, and NGO personnel. The survey was sent to 374 unique IFMA member email addresses, 106 responses were returned with 63 of those responses being complete. Responses were received from 24 countries. 23.8% of the respondents were teachers/professors, 19 % were Extension agents/specialists, 22% of the respondents were consultants/advisers, and 11% each were farmers or agribusiness staff. Respondents indicated funding for these services delivered came 19% almost entirely from government sources, 40% self-funded, and nearly 34% a mixture of user, government, and NGO funding. Access to farm management services varied from nearly every farm family having face-to-face availability to less than one third of farm families having access. 35% of respondents indicated the most important need for improved technology transfer was closer collaboration between research institutions and all types of farm management professionals. Another 20% each identified that more trained personnel and better training for personnel are the greatest needs. Another product of this survey was a list of URLs of agricultural technology webpages from each participant's country. The authors discovered a wealth of information in the written responses which provide color to the survey results. One such response, from New Zealand, indicated that the real solutions to farm management issues are derived at the farm level not coming from "governmental or university research elites". Further analysis of the survey responses is ongoing. Hypotheses being tested include: 1) countries characterized by large, high income farms are more likely to rely on privately funded technology transfer systems; 2) countries with lower GDP per capita are more likely to exhibit inadequate or nonexistent technology transfer programs; and 3) countries with inadequate technology transfer programs exhibit the lowest agricultural productivity. Among potential conclusions is that farmers in low GDP countries are in need of the technology transfer skills of IFMA members. Future research inquiries will address additional aspects of farm management technology and its transfer. For example, more information is needed about the extent and effectiveness of electronic media use to transfer farm management technology in each country. The authors invite suggestions for improving and creating lines of inquiry concerning the structure, funding, delivery, and efficiency of farm management technology transfer within countries. An ultimate goal is to enhance farm management and agricultural productivity across national borders.

Keywords: extension, technology transfer, farm management

POLICY CHANGES AND VOLATILITY IN DAIRY MARKETS

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Abstract

Volatility in dairy commodity markets has become a major concern for many in the dairy supply chain and is likely to remain so in the future. Changes to the Common Agricultural Policy (CAP) over the past decade have more closely aligned European Union (EU) and World prices and their associated volatilities. There are a number of reasons that lead us to expect that Ireland may be more exposed to dairy price risk than other EU countries. These include the highly seasonal nature of production, dependence on third country markets, exposure to currency fluctuation and the grass based nature of Irish milk production which is conditioned by weather variations. Factors which contribute to volatility in agricultural commodity prices include low levels of inventory, inelastic supply and demand responses, climatic shocks and policy changes. The aim of this paper was to measure volatility at farm level in Ireland over time, identify possible reasons for the increased volatility and identify ways of reducing volatility. Price volatility was defined as a directionless measure of the extent of the variability of a price. Statistical measures, coefficient of variation (CV) and annualized standard deviation were used to provide measures of past volatility and its evolution over time. Family Farm Income (FFI) data, input data and farm gate milk prices were used to highlight historical farm level volatility. As farm level prices should be based on dairy commodity returns the links between commodity and the farm gate prices are explored. Monthly wholesale prices for Skim Milk Powder (SMP), whole milk powder (WMP) and butter between January 1997 and March 2012 were used for this analysis. The time period was divided into two sub periods to quantify changes in volatility pre and post the Luxembourg Agreement. Results highlight that commodity volatility has increased dramatically post 2007. This commodity price volatility has translated along the supply chain to farm gate prices, farm input prices and farm income, ultimately leading to greater income volatility. The increased level of volatility and its possible adverse consequences have been acknowledged by EU policy makers, however the shift from commodity to income support continues implying that future measures will be designed to deal with crises rather than "normal" market price fluctuation regardless of their magnitude. It should also be noted that private markets solutions are been explored and developed. In recent years a number of EU based dairy futures have been launched for Butter, SMP and Whey. Finally, the implications of this work highlight that risk assessment and management strategies must be considered in order to cope with adverse consequences of greatly increased volatility. Volatility will become a more inherent part of the dairy industry as policy changes cause prices to become further aligned with world prices.

Keywords: dairy, volatility, Ireland, policy[1]

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ARE MACEDONIAN FARMERS WILLING TO JOIN EU? – ATTITUDES AND EXPECTATIONS

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Abstract

Macedonia is a candidate-country for EU membership since 2005. There are many discussions and research projects about the impact that the EU integrative process will have on the Macedonian economy and particularly on the agricultural sector, which is one of the most significant sectors in terms of GDP contribution and as a workforce employer. Usually, the focus is on the process of adaptation to the European legislation and the future development of agricultural markets. There are not many research projects about the knowledge and expectations of Macedonian farmers with regard to the impact of EU accession. Are they aware of the real needs and obligations? Are they ready to put in energy, time and money in order to gain the benefit from the EU accession they are being told? In this respect, the objective of the research is to provide an understanding and description of the Macedonian farmers' attitudes and behavioural intentions in the context of the EU accession.

Farmers' behaviour is often shaped by farmers' personal beliefs and experiences, their traditional heritage and specific socio-economic environment in which they are operating with their limited educational level and resources; or in other words, the characteristics of the farmer, the farm and the operating environment Grouping farmers according to some relevant characteristics is elemental for modelling their behaviour. Thus, the paper uses few theories as theoretical basis: Theory of Planned Behaviour, Resource-Learning Theory, Farm Management Theory and Decision Making Theory.

The data collection was carried out with face-to-face interviews of 489 farmers in the Republic of Macedonia in the period March-April 2012. The research uses hierarchical cluster analysis, using Ward's method with squared Euclidean distance and within-case standardization (in SPSS 17). Prior to the cluster analysis, factor analysis was made at the attitudinal statements used as cluster variates. Statistics tests were used to assess the homogeneity between groups for a given variable (Kruskal-Wallis H test) and to verify which variables determine the difference between clusters (Mann-Whitney test). The farmers' profiles with similar attitudes were portrayed by descriptive statistics. Friedman's ANOVA was used on variables with several distinct forms, to compare them among separate clusters.

The cluster analysis suggests four distinctive groups of farmers according to the farmers' attitudes and expectations from the EU accession which can provisionally be labelled as "optimist/willing", "moderate", "restrained" and "sceptic". The analysis shows that the clusters differ not only in terms of farmers' attitudes towards EU accession, but also in terms of their personal and farm management characteristics. The most significant differences between the clusters are the variables explaining farm legal structure, education, some farm management activities including investments by type, personal and farm objectives, farmers' sources of information and knowledge on CAP and the pre-accession funds.

Keywords: cluster analysis, EU accession, farmers' attitude

MIGRANT E. EUROPEAN LABOUR FILLING A GAP IN UK DAIRY FARM'S NEEDS AS THEY GROW IN HERD SIZE – A CASE STUDY OF A EUROPEAN SUCCESS STORY

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Tropical Agriculture Association

Abstract

Over recent decades the number of dairy farmers in the UK has declined; a process accelerated by the foot and mouth disease outbreak in 2002. Meanwhile herd size on those farms continuing in milk production has risen so that total national milk production has remained at about the same level.

Another issue which arose in the early part of the last decade was the opening up of the UK borders to the new Countries of Eastern Europe which became members of the European Union at that time. In particular there was a large influx of Poles who made a huge contribution to the British labour force. Not only were the well known skills such as plumbing enhanced but many also entered the agricultural work force especially as seasonal workers in fruit and vegetable production. It is less well known that many also came to work on dairy farms at a time when it was difficult to recruit local staff prepared to face the hard work and long hours of the job.

This case study illustrates a tenanted dairy farm in a village near Bath on land belonging to the Duchy of Cornwall. Polish labour was recruited through an agency some years ago and an excellent relationship created with the farmer such that a good number of the worker's family have followed on from one another over the years.

However as the economic benefit of a favourable exchange rate between the pound and the euro has declined so this family has returned to their homeland in common with many others.

The new order that has evolved suggests that it is now more difficult to recruit reliable labour from outside the United Kingdom let alone within.

Within the last couple of years there has been a huge interest in and uptake of robotic milking systems.

Will these fill the gap in the shortage of labour?

Keywords: migrant, labour, dairy

LINEAR PROGRAMMING MODEL – THE CASE OF VEGETABLE PRODUCTION PLANNING IN REPUBLIC OF MACEDONIA

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Abstract

The changing environment in which farmers operate represents a big challenge in the decision making and improving their production. Farmers should make simultaneous decisions concerning the production, procurement, marketing and financial management. To increase economic efficiency and to support decision making, different tools could be applied, that beside the natural, technical and technological conditions, consider also the economic aspects.

In this research we focus on Macedonian farms specialised in vegetable production. The aim is to develop an optimization model for analysis of decision-making on Macedonian family farms, based on mathematical programming paradigm. It enables in-depth analysis of production planning, based on neoclassical view of decision maker. Optimal production plan is determined through LP, maximising expected gross margin, subject to a set of different constraints.

The constructed general production model is set in MS Excel and Visual Basic, and contains 162 decision variables divided into four groups. The first group of activities refers to the most representative vegetable crops thus reflecting the typically diversified production structure on Macedonian vegetable farms. In this regard, ten vegetable crops are included: tomato, pepper, cabbage, carrot, watermelon, potatoes, lettuce, broccoli, onion and beans. Input related activities are presented in the second group of decision variables. The third group of activities captures the infrastructure capacity of the farm. Balance activities, as a fourth group, are determined in order to assure integrity of the solutions.

Farmers are expected to make decisions under a number of constraints, dealing with production factors scarcity, agronomic limitations and constraints capturing the external factors that affect the production.

A combination of different sources of data was used for supporting the model. Basic data for calculating the enterprise budgets were obtained by a panel of relevant experts: researchers, crop technology specialists, input suppliers and vegetable farmers, supplemented with the Farm Monitoring System for 2010. Model was applied on "typical vegetable farms" that were determined through cluster analysis (in SPSS 17).

The developed model for optimisation of vegetable production proved to be useful when analysing a farm management problem in Macedonia. The tool for optimisation of vegetable production with an objective function of maximising the expected gross return is functional and gives plausible results in reference to the available working capital, farm size, production structure as well as the technological, market and policy constraints. The findings reflect to a large extent the situation in practice. The model revealed that the labour is not a binding constraint; however, in the peak seasons the family labour cannot fulfil all requirements, and hence additional seasonal labour is hired. Sensitivity analysis has shown on available working capital as an important binding issue on analysed Macedonian farms. Its influence on optimal production structure as well as on expected return, land and labour was further analysed with parameterisation.

Developed model is flexible, enabling different crop enterprises to be added additionally. It could be also applied for optimising the farm situation in the countries in the region, considering the similar structure of their agricultural production as well as similar production technologies.

Keywords: linear programming, vegetable farms, production planning

CASH RENT SURVEY DATA - NATIONAL AGRICULTURAL STATISTICS SERVICE (NASS) VS. LAND GRANT SURVEYS – WHY THE DIFFERENCES?

Barry Ward

The Ohio State University Department of Agricultural, Environmental and Development Economics; Ohio State University Extension Leader, Production Business Management

Abstrakt

Unprecedented profitability in grain farming in the U.S. has led to an escalation in cash rental rates. Landowners and farmers have found it increasingly hard to agree on an equitable cash rent as crop prices and input costs have experienced significant volatility over the last several years. Cash lease rates aren't public knowledge and don't have a public clearinghouse such as a futures exchange which means information on rates is often sketchy. Farmers with full yield and profit information are often reluctant to share this information with the landowner for fear of rent escalation. Landowners knowing there is significant value in "fringe benefits" that farmers provide (snow clearing, rock removal, fence-row maintenance, tiling, etc..) may be reluctant to recognize this value in the negotiation process. Farmer: "I'm only paying $125 per acre for a similar farm" or landowner: "my neighbor is getting $200 per acre for land that isn't near the quality of mine" are often part of the discourse as landowners and tenant farmers negotiate for an equitable lease amount.

Rent surveys are conducted by NASS and many Land Grant Universities in an attempt to provide decision-makers baseline data. NASS has conducted surveys since 2008, surveying farmers regarding cash rental rates they presently pay on farms they rent. These survey data are summarized and published as an average cash rent by county.

Land Grant Universities conduct land rental surveys by surveying professional serving the agricultural industry. These professionals include agricultural lenders, rural appraisers, professional farm managers, extension professionals, and others. These survey data are summarized and published as averages by land production class and by region.

NASS survey results consistently yield lower rents than Land Grant University survey results for average land production class.

Two issues drive the differences in these survey results. First, survey questions are not the same. NASS cash rent surveys ask respondents to report the cash rent on parcel. Land grant surveys ask respondents to indicate average cash rents for each land production class for recently rented parcels. This difference may lead land grant survey respondents to return results that are indicative of marginal cash rents as they are asked to provide data for recently rented parcels. The NASS survey effort does not stipulate that the returned information be from recently rented parcels and may reflect lower rental rates from long-standing rental agreements.

The second major difference between these two surveys is that they survey different populations. The NASS cash rent survey effort surveys farmers while land grant universities survey agricultural professionals. Farmers, with knowledge that their survey responses are summarized and published for public consumption may not choose to respond with a high cash rent on their highest quality rented parcel. These differences are highlighted in this study as we examine survey question construction and motives of the two separate survey populations.

Keywords: cash rent, surveys

FLEXIBLE CASH FARM LEASES, PRACTICAL OPTIONS

Barry Ward

The Ohio State University Department of Agricultural, Environmental and Development Economics; Ohio State University Extension Leader, Production Business Management

Abstract

Landowners and farmers have found it increasingly hard to agree on an equitable cash rent as crop prices and input costs have experienced significant volatility recently. Cash lease rates aren't public knowledge and don't have any public clearinghouse such as a futures exchange so information on rates is often sketchy. Farmers with full yield and profit information are often reluctant to share this information with the landowner for fear of rent escalation. Landowners knowing there is significant value in "fringe benefits" that farmers provide (snow clearing, rock removal, fence-row maintenance, tiling, etc.) may be reluctant to recognize this value in the negotiation process. Flexible cash leases do allow flexibility but they may not be for everyone. They do require more communication between landowner and farmer. They also require more management and record keeping. These flex leases typically require a sharing of data from the farming operation and have a set of mathematical calculations that need to be performed at the end of the lease period. Since most flex leases require some combination of yield and price, there needs to be verification mechanisms agreed to and written into the lease. The following two examples display two different flex lease methods.

Cash Lease with a Bonus Approach. Tenant and Landowner agree on:

- *Base Rent (and Max Rent?) Base Rent should be below market rent due to landowner upside.*
- *Base Gross Revenue (Agreed upon price x yield combo or Tenant Cost of Production plus X$s?).*
- *How to calculate and verify Actual Year-End Revenue (Yield and Price verification)?*
- *How Extra revenue (Actual Revenue – Base Revenue) is shared? What %?*

Example:

- *Base Rent: $150 (Max: $250),*
- *Base Revenue: $869 (158bpa*$5.50/bu.),*
- *Excess revenue shared: 33% to landowner,*
- *Actual Revenue: $1018 (177bpa*$5.75),*
- *Bonus: ($1018-$869)*33% = $50,*
- *Total Flex Cash Lease Amount: $150 + $50 = $200/acre,*
- *Percent of Gross Income Approach,*

Tenant and Landowner agree on:

1. *Minimum Rent (and Max Rent?) Min. Rent should be below market rent due to landowner upside.*
2. *How to calculate and verify Actual Year-End Revenue (Yield and Price verification).*
3. *Percent of gross income as rent by crop.*

Example:

- *Minimum Rent and Maximum Rent: Minimum$150 and Maximum $250.*
  Percent of Gross Income as Rent: corn – 28%, soybeans – 37%.
  Actual Revenue: corn – $750 (150bpa$5.00), soybeans – $552 (46bpa*$12.00).*
  *Rent: corn -$750*28% = $210/a, soybeans -$552*37% = $205/a*

The verification part of a flex lease is often the trickiest part of the whole arrangement. The price component verification can be easily solved by choosing a market destination for price averaging in the flex lease calculation that is accessible to both tenant and landowner. The difficult parameter to verify in most flex lease calculations is the yield component. Weight tickets, yield maps, bin measurements or crop insurance yield submissions are viable options.

Keywords: cash rents, leases, land, flexible cash leases

19th International Farm Management Congress

21-26 July 2013, Warsaw, Poland

AGRICULTURE IN ROMANIA

Ester Bjerregaard Brezuleanu, Iulian Brezuleanu

***Country** – Romania*

***Population** – 21,5 mil*

In urban areas – 11,9 mil

In rural areas – 9,6 mil

***Agricultural land area** – 13.298 k ha (k= 1000)*

***Arable land** – 8.305 k ha*

***Permanent grassland** – 317 k ha*

Employed in agriculture – 9.240 k

Cow's milk collected and production of milk products

	MU	May 2012	Apr. 2013 [p]	May 2013 [p]	The period 1.I – 31.V. 2012	The period 1.I – 31.V. 2013 [p]
Cow's milk collected by processing units	tonnes	92391	72097	86588	371923	351159
Average fat content	%	3.72	3.78	3.73	3.80	3.81
Average protein content	%	3.23	3.27	3.26	3.25	3.27
Milk products obtained						
Drinking milk	tonnes	18694	18548	19326	94766	94180
Cream	tonnes	3865	4256	4067	19145	21384
Acidified milk [*)]	tonnes	13863	13722	14831	64250	71754
Butter	tonnes	754	926	677	3874	3983
Cheese products - total -	tonnes	7107	6097	7401	27784	27815
of which: cheese obtained exclusively from cow's milk	tonnes	6066	5650	6530	25379	25382

[p] Provisional data. [*)] it includes yoghurt, drinking yoghurt, curd and others

NATURAL CONDITIONS

Atmospheric precipitation

Weather station	Annual precipitation (mm)
Satu Mare	995,6
Suceava	869,8
Oradea	876,2
Iaşi	581,2
Cluj-Napoca	811,8
Târgu Mureş	735,5
Bacău	825,6
Timişoara	790,3
Deva	759,1
Sibiu	718,5
Vârfu Omu	1367,1
Galaţi	682,4
Târgu Jiu	981,4
Buzău	513,8
Calafat	590,1
Turnu Măgurele	644,7
Bucureşti-Filaret	659,6
Constanţa	583,8

The air temperature

grade Celsius

Average annual	Maxim annual Val.	Maxim annual Data reg.	Minim annual Val.	Minim annual Data reg.
10,3	36,0	14.VIII	-15,6	28.I
8,4	33,6	13.VIII	-24,7	26.I
11,0	36,0	15.VIII	-14,8	25.I
10,4	38,1	13.VIII	-26,9	26.I
9,3	33,8	13.VI	-18,1	25.I
9,9	35,9	14.VIII	-21,9	25.I
9,8	35,8	13.VIII	-25,9	25.I
11,6	35,9	15.VIII	-12,9	28.I
10,5	35,1	12.VI	-16,6	25.I
9,8	34,0	12.VI	-24,2	25.I
-1,8	18,5	27.VIII	-24,2	25.I
11,8	37,6	13.VIII	-21,5	25.I
10,9	35,5	14;15.VIII	-18,0	25.I
11,6	37,3	13.VIII	-25,7	26.I
11,9	39,0	28.VIII	-21,0	25.I
11,9	38,0	15.VIII	-21,8	27.I
12,0	38,1	13.VIII	-18,9	26.I
13,1	34,7	11.VIII	-17,8	25.I

Agricultural structure of Romania, 2012

Farming type	Size (ha)	Nr. (x1000)	%	Surface (x1000 ha)	%
1. Households unfunded	< 1	2 740	71,1	5 073	34,5
2. Subsistence farming and subsistence	1–10	1 044	27,1	3 108	21,2
Commercial farms:	10–55 000	72	1,8	6 504	44,3
3. familial	10–50	(60)	(1,5)	(1 494)	(10,2)
4. firma	100–55 000	(12)	(0,3)	(5 010)	(34,1)
TOTAL x		3 856	100,0	14 685	100,0

Slaughtering of animals and poultry

	Slaughtered animals and poultry - thou heads -			Carcass weight - tonnes -		
	Mar. 2012	Feb. 2013	Mar. 2013[1)]	Mar. 2012	Feb. 2013	Mar. 2013[1)]
Cattle – total	**45**	**50**	**49**	**7239**	**8247**	**7529**
Of which: in specialized industrial units (slaughter houses)	10	9	9	2040	1977	1987
Pigs – total	**306**	**306**	**320**	**24443**	**25821**	**26850**
Of which: in specialized industrial units (slaughter houses)	262	251	292	22091	21810	25484
Sheep and goats – total	**330**	**101**	**534**	**3258**	**1375**	**4898**
Of which: in specialized industrial units (slaughter houses)	41	2	36	338	43	294
Poultry – total	**20461**	**17416**	**18998**	**32591**	**27830**	**29899**
Of which: in specialized industrial units (slaughter houses)	15993	14804	16148	25423	24175	26050

Cultivated area and production of major crops

	Cultivated area x1000 ha		Production -x1000 tone-		Diference (±) 2012 2011	
	2011	2012	2011	2012	-1000 ha-	-1000 tone-
Cereals for grain:	**5225**	**5416**	**20842**	**12698**	**+191**	**-8144**
-wheat	1947	1988	7132	5215	+41	-1917
-barley	420	412	1330	968	-8	-362
-oats	185	192	376	336	+7	-40
-maize	2590	2729	11718	5922	+139	-5796
Grain legumes	**42**	**43**	**77**	**60**	**+1**	**-17**
Oil plants:	**1473**	**1214**	**2687**	**1659**	**-259**	**-1028**
-sunflower	995	1020	1789	1389	+25	-400
-soya	72	78	143	102	+6	-41
-rape	393	108	739	159	-285	-580
Sugar beet	**19**	**28**	**660**	**739**	**+9**	**+79**
Potatoes	**243**	**223**	**4077**	**2464**	**-20**	**-1613**
Vegetables	**263**	**254**	**4176**	**3457**	**-9**	**-719**
-tomato	52	48	911	654	-4	-257
-cabbage	47	48	1025	975	+1	-50
-cucumbers	13	12	196	146	-1	-50
-carrots	17	16	246	200	-1	-46
-onion	33	32	394	337	-1	-57
-peppers	20	19	254	203	-1	-51
-melons green and yellow	31	31	645	555	-	-90

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Source: NATIONAL INSTITUTE OF STATISTICS ROMANIA

19th International Farm Management Congress

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AGRICULTURE IN BELGIUM

Evelien Lambrechtm, Prof. Dr. X. Gellynck

Ghent University, Faculty of Bioscience Engineering, Department of Agricultural Economics

Country – 30 528 km²

Population – 10,709,972

In urban areas – 10,427,229

In rural areas – 282,743

Agricultural land area – 133.391.300 ha

Arable land – 82.667.633 ha

Permanent grassland – 50.723.667 ha

Employed in agriculture – 58,337 (+/-1.2% of total employment)

NATURAL CONDITIONS

Climate zone: Warm temperate

Soil types: Clay, sand, sand-loam, loam

Temperature:

Average maxima : 28 (Ardennes) -32°C (lower Belgium)

Average minima: -10°C (lower Belgium) - -19°C(Ardennes)

Rainfall:

Average: 800 mm (lower Belgium) - 1,200 mm (Ardennes)

200 rainy days

Source: http://www.meteo.be/meteo/view/nl/360361-Parameters.html

FARM STRUCTURE

Number of farms: 38,559

Average surface used per farm: 23.6 ha

Legal status:

Natural person: 33,765

Legal person: 4,794

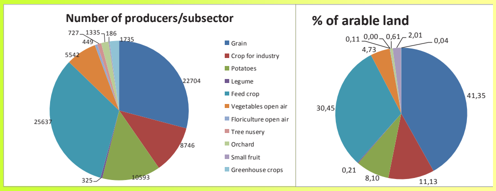
Employed: 75,589 - 58,337 FTE

Family: 60,060 - 41.738 FTE

Non-family: 15,529 - 16,599 FTE

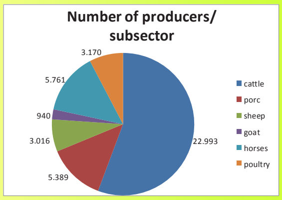
Sources: Belgian Federal Government, Directorate-general Statistics and Economic information, agricultural survey May 2012 ;
Platteau J., Van Gijseghem D., Van Bogaert T., Maertens E.(reds) (2012) Landbouwrapport 2012, Departement Landbouw en Visserij, Brussel

CROP PRODUCTION



Source: Belgian Federal Government, Directorate-general Statistics and Economic information, agricultural survey May 2012

ANIMAL PRODUCTION

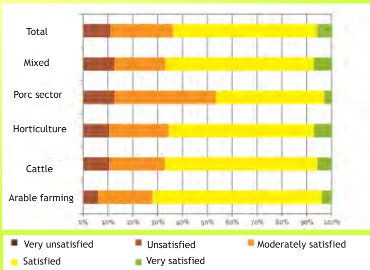


Source: Belgian Federal Government, Directorate-general Statistics and Economic information, agricultural survey May 2012

LAND USE

Source: http://mapas.owje.com/maps/8356_belgium-

TOTAL SATISFACTION PER SUBSECTOR



Source: Department Agriculture and fischeries (Belgium)

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19th International Farm Management Congress

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AGRICULTURE IN THE REPUBLIC OF MOLDOVA

Ana Machidon

Warsaw University of Life Sciences—SGGW

***Country** — 33,846 km^2*

***Population** — 3,559,500*

In urban areas — 41%

In rural areas — 59%

***Agricultural land area** —2243540,02 ha*

***Arable land** — 73%*

***Permanent grassland** — 14%*

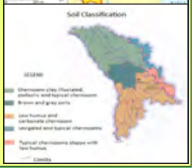
***Employed in agriculture** — 323020*

***Share of agriculture in GDP** — 15%*

NATURAL CONDITIONS

Moldova's climate is moderately continental: the summers are warm and long, with temperatures averaging about 20 °C (68 °F), and the winters are relatively mild and dry, with January temperatures averaging−4 °C (25 °F). Annual rainfall, which ranges from around 600 mm (24 in) in the north to 400 mm (16 in) in the south, can vary greatly; long dry spells are not unusual.

About 75 percent of Moldova is covered by a soil type called black earth or chernozem. In the northern hills, more clay textured soils are found; in the south, red-earth soil is predominant. The soil becomes less fertile toward the south but can still support grape and sunflower production. The hills have woodland soils, while a small portion in southern Moldova is in the steppe zone, although most steppe areas today are cultivated. The lower reaches of the Prut and Dniester rivers and the southern river valleys are saline marshes.



Source: http://en.wikipedia.org/wiki/Moldova#Climate

FARM STRUCTURE

The optimum farm size is difficult to define because opinions about the farmers' objective function differ and because the same determinants can affect farm size in different ways across different farms or countries.

In the absence of a universal optimum, average farm sizes can be meaningfully compared only for countries with similar natural conditions.

The average farm size is 2.49 ha.

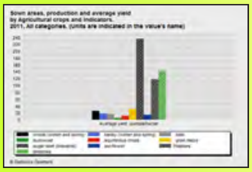
The average size of small agricultural unit is 0.06 ha.

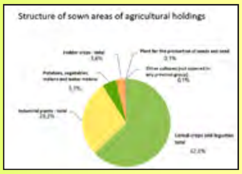
Source: National Bureau of Statistics, www.statistica.md

CROP PRODUCTION

Sown areas, production and average yield by Agricultural crops, Categories of producers, Indicators and Years				
	All categories			
	Production, thousand tonnes			
	2008	2009	2010	2011
Cereals and leguminous crops - total	3,170	2,176	2,421	2,496
..wheat (winter and spring)	1,286	737	744	795
..barley (winter and spring)	353	261	206	194
..oats	4	1	3	3

Source: National Bureau of Statistics, www.statistica.md



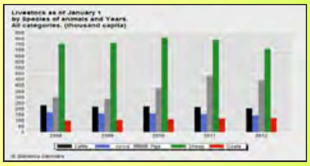


Source: National Bureau of Statistics, www.statistica.md

ANIMAL PRODUCTION

Production of animal products by Main animal products, Categories of producers and Years				
	All categories			
	2008	2009	2010	2011
Sale of cattle and poultry for slaughter (in live weight)	108.2	124.5	150.0	159.0
..cattle	17.6	18.4	16.9	16.1
..pigs	44.7	53.8	72.5	81.4
..sheep and goats	4.8	4.6	4.7	4.7
Milk	510.5	538.9	591.2	525.8

Source: National Bureau of Statistics, www.statistica.md



Source: National Bureau of Statistics, www.statistica.md

INTERNATIONAL TRADE

In 2011, Moldova"s foreign trade balance with food products, animals, beverages and tobacco was positive, with an excess worth 14.2 mil. USD. Fruits and vegetables were the most valuable category of exported food products in 2011, and the destination of these exports, with small exceptions, was rather Commonwealth of Independent States markets (Russian Federation, Ukraine and Belarus) and Romania.

	Export	Import	Balance	Top in export	Top in import
Live animals	8.2	5.7	2.5	9	12
Meat and meat products	21.6	33.5	-11.9	5	8
Diary and eggs	10.8	33.3	-22.5	8	9
Fish, crustaceans and molluscs		46.8	-46.8	12	7
Cereals and cereal derived products	86.1	77.3	8.8	3	3
Fruits and vegetables	280.7	132	148.7	1	1
Sugar, sugar and honey derived products	15.8	23.1	-7.3	7	10
Coffee, tea, cacao, spices and their substitutes	3	55.5	-52.5	10	5
Livestock feed	17.5	19.1	-1.6	6	11
Diverse food products and derivates	2.6	74.6	-72	11	4
Beverages	180.9	47.9	133	2	6
Tobacco	28.7	92.9	-64.2	4	2
TOTAL	655.9	641.7	+14.2	x	x

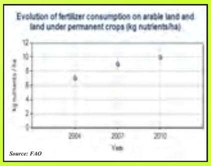
Source: http://www.rusia.mfa.md/img/docs/organic-agric-md-perspectives.pdf

ACCESS TO NUTRIENTS

The bulk of national market of fertilizers is made of imports. 338 companies were licensed to import and trade fertilizers as of November 2012. Regionally, Moldovan agriculture incorporated the least of fertilizers, way less than some European countries such as Germany, Italy. The situation is explained by the lack of finance to purchase such operating inputs. According to FAO data, fertilizer consumption on arable land and land under permanent crops in 2010 was 10 kg of nutrients/ ha. According to the agricultural land, the nutrients used have an increased number in comparison to the year 2002 (table).

	Nitrogen nutrients			Phosphate nutrients			Potash nutrients			Agriculture land
Ukraine	443492	748365	68,7	33129	197909	497,4	42436	167322	294,3	41276
Russian Federation	654204	1192680	82,3	313151	436980	39,5	705909	263210	-62,7	215961
Romania	239071	305757	27,9	72996	123111	68,8	14056	51500	266,4	13523
Republic of Moldova	14700	16400	11,6	200	2400	X12	100	1300	X13	2472
Poland	831700	1294223	55,6	302600	388382	28,3	377400	462157	22,5	16119
Lithuania	13653	106716	681,6	67412	54481	-19,2	99479	42605	-57,2	2689
Latvia	36047	58643	62,7	4546	16150	255,3	8636	16288	88,6	1833
Italy	845003	498605	-41,0	316143	180254	-43,0	256941	185518	-27,8	12908
Germany	1787833	1786485	-0,1	327387	286348	-12,5	479673	433743	-9,6	16886
France	2203200	2050015	-7,0	713300	294500	-58,7	965100	431730	-55,3	29260
Estonia	16700	28628	71,4	4015	6117	52,4	6292	9366	48,9	931
Czech Republic	151778	255423	33,2	41409	46116	11,4	30555	55756	82,5	4239
Austria	170074	86153	-49,4	77511	23624	-69,5	75636	38188	-49,5	3927

Source: FAO



Source: FAO

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AGRICULTURE IN POLAND

Sylwia Małażewska, Monika Walczak, Marta Borowiecka

Warsaw University of Life Sciences

Country *– 322 575 000 km²*

Population *– 38 512 000*

In urban areas – 60%

In rural areas – 40%

Agricultural land area *– 15 442 000 ha*

Arable land *– 74%*

Permanent grassland *– 21%*

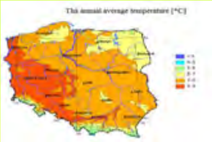
Other *– 5%*

Employed in agriculture *– 2,3 mln (16% of workforce)*

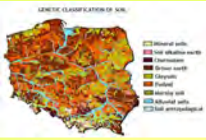
Share of agriculture in GDP *– 3,6%*

NATURAL CONDITIONS

The climate in Poland is generally temperate, with relatively cold winters and warm summers, and is greatly influenced by both oceanic air currents from the west, and cold polar air from Scandinavia and Russia, as well as warmer, sub-tropical southern air. The average yearly temperatures ranges from 6°C to 8.5°C, while the annual rainfall is around 500 mm to 700 mm.



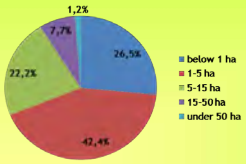
Nearly 80% of the Polish cover complex brown soils, podzolic and fawn. They are common in the lowlands, a little less there on the hills and mountains (especially podzols). In terms of the usefulness of the most valuable agricultural soils are brown.



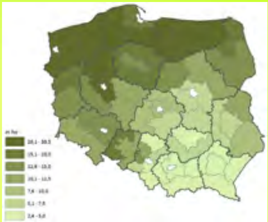
Sources: imgw.pl; weatheronline.co.uk

FARM STRUCTURE

Share of agricultural holdings in total number of agricultural holdings



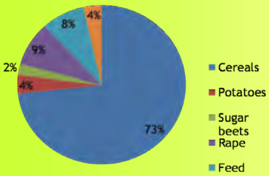
Average area of agricultural holdings conducting agricultural activity in rural areas by subregions in 2010



Source: Central Statistical Office.

CROP PRODUCTION

Share in cropping structure



Crop	Yields [t/ha]
Cereals	**3,4**
Wheat	4,1
Rye	2,4
Barley	3,2
Oats	2,5
Potatoes	**23,2**
Sugar beets	**57,4**

Source: Central Statistical Office.

ANIMAL PRODUCTION

Share of animal production (in %) of total Gross Agricultural Output in 2012

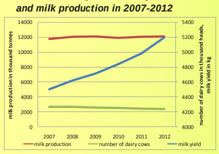
Specification	2012
Animal production	44,6
milk	15,9
cattle (excl. calves)	3,9
pigs	10,1
poultry	9,3

Source: Central Statistical Office GUS.

Poultry production

Specification	2011
Hen eggs in bn units	10,4
Hen eggs in units per capita	269
Poultry in thousand heads	139964
Poland's place in production of hen eggs (in the EU)	7
Poland's share in production of hen eggs (in the EU)	8 %

Number of dairy cows, milk yield and milk production in 2007-2012



Source: Seremak-Bulge J., Analizy rynkowe. Rynek mleka. Stan i perspektywy, kwiecień 2013.

Structure of pig production in Poland according to the number of heads

POLISH PROTECTED PRODUCTS

Protected Designation of Origin (PDO)

(So far 9 products have received the PDO sign in Poland)

Protected Geographical Indication (PGI)

(So far 18 products have received the PGI sign in Poland)

Traditional Speciality Guaranteed (TSG)

(So far 9 products have received the TSG sign in Poland)


cheese from the Podhale region *(bryndza podhalańska)*


apples from Grójec


półtorak mead


oscypek cheese


bagel from Cracow *(obwarzanek krakowski)*


kabanosy sausage


nadwiślanka cherries

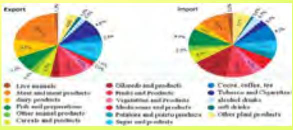

wafers from the Kalisz region


pierekaczewnik pie

Source: http://www.minrol.gov.pl

INTERNATIONAL TRADE

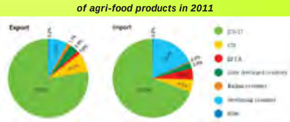
Commodity structure of exports and imports of agri-food products in 2011



In the trade of agri-food products - in terms of value - dominated industry products food, whose share in the proceeds from the export of Polish food is 85%. The share of processed products of the agri-food imports is still high, but in comparison to 2010 increased slightly (to 69.8% compared to 69.3% in the previous year).

The geographical structure of exports and imports of agri-food products in 2011

In 2011, the turnover increased foreign trade of agri-food products with all groups countries, especially the developing countries, the Balkans, the WNP, and to a lesser extent with EU countries.



Source: http://www.minrol.gov.pl

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19th International Farm Management Congress

21-26 July 2013, Warsaw, Poland

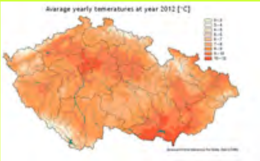
AGRICULTURE IN CZECH REPUBLIC

Aleksandra Maršíková
Warsaw University of Life Sciences

Country *– 78 866 km^2*
Population *– 10 512 782*
In urban areas – 70%
In rural areas – 30%
Agricultural land area *– 4 264 000ha (54% of total area of the country)*
Arable land *– 41%*
Forests *– 34%*
Permanent grassland *– 13%*
Other *– 11%*
Employed in agriculture *– 420 500 (4% of workforce)*
Share of agriculture in GDP *– 2,4%*

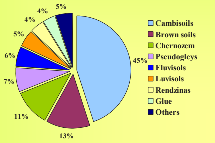
NATURAL CONDITIONS

The climate in Czech Republic is temperate, with relatively short but warm summers and cold winters. The climate varies considerably across regions, which is primarily related to the height above sea level. The average yearly temperatures is 7,3°C, while the annual rainfall ranges from 401 mm to 1702 mm. The highest average temperature has e.g. Prague 8,5°C.



Source : http://portal.chmi.cz

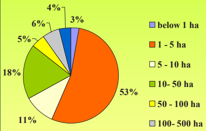
The most common soil type in Czech Republic is cambisol. It makes up 45% of soils and are at various altitudes. It is used for agricultural and forestry purposes – grown on them less demanding crops (beet, forage rape). Brown soils are represented at 13% of agricultural land -used for growing cereals and beet. Chernozem creates 11% of agricultural soils - grown on them wheat, corn, sugar beets, grapes, fruit and vegetables, hops. Pseudogleys occupy 7% of land - used as meadows. Fluvisols are typical soils along watercourses.



Source : http://http://vitejtenazemi.cenia.cz

FARM STRUCTURE

Share of agricultural holdings in total number of agricultural holdings



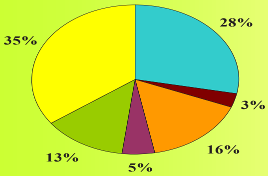
Source: Czech Statistical Office. CZSO 2011

Average area of agricultural holdings by legal form in rural areas by subregions in 2007

Source: Czech Statistical Office. CZSO 2011

CROP PRODUCTION

Structure of harvest crops

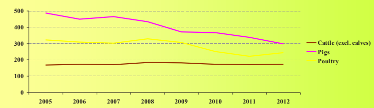


Crop	Yields [kg/ha]
Cereals	50,8
Corn for grain	76,8
Potatoes	270,4
Sugar beets	528,4
Rape	32

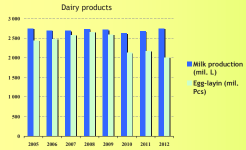
Source: Czech Statistical Office. CZSO

ANIMAL PRODUCTION

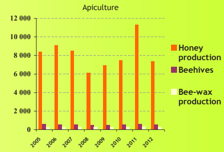
Production of livestock for slaughter (at thous. t of live weight)



Dairy products



Apiculture



Source: Czech Statistical Office. CZSO

CZECH PROTECTED PRODUCTS

Protected Designation of Origin (PDO)
(So far 6 products have received the PDO sign in Czech Republic)

Pohořelický kapr - carp

Žatecký chmel - hops form Žatecko region

Český kmín - Czech cumin

Protected Geographical Indication (PGI)
(So far 22 products have received the PDO sign in Czech Republic)

Different types of beer e.g: Českobudějovické pivo, Budějovické pivo, Chodské pivo, České pivo, Znojemské pivo, Brněnské pivo , Starobrněnské pivo, Březnický ležák.

Karlovarské oplatky - wafers from Karlovy Vary region

Jihočeská Niva – blue cheese from south of Czech Rep.

Traditional Speciality Guaranteed (TSG)
(So far 4 products have received the PDO sign for Czech Republic & Slovakia)

Špekáčky – type of sausage

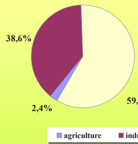
Lovecký salám

Spišské párky - frankfurter

Source: http://ec.europa.eu

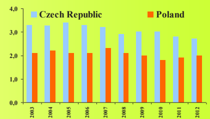
CZECH TOURISM

GDP compositions by sectors in 2011



2,9 % Tourism

% contribution of tourism in GDP



The most attractive destination in Czech Republic is its capital city – Prague. Two thirds of all foreign tourists visits the city during their jurney. Prague is one of the Twelve Czech wonders of the world entered in the UNESCO List, next to: Český Krumlov, Brno, Kutná Hora, Telč, Třebíč.
The Czech Republic was mostly visited by tourists from Germany (60%), Hungary (14%), Slovakia (14%) and Poland (11%) at 1Q 2013.

Source: http://www.wttc.org

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19th International Farm Management Congress

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AGRICULTURE IN UZBEKISTAN

Timur Pamukchi, Sodikjon Mamasoliev

Warsaw University of Life Sciences

Country *– 447,400 km²*

Population *– 29 555 400*

In urban areas – 36%

In rural areas – 64%

Cultivable land *– 4 400 000 ha*

Arable land *– 10%*

Permanent grassland *– 0.8%*

Employed persons in agriculture *– 7 979 958*

Share of agriculture in GDP *– 24%*

NATURAL CONDITIONS

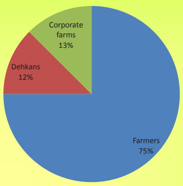
Climate Large areas of Uzbekistan are desert. Summer is long, hot and dry; spring is mild and rainy; autumn has light frosts and rains; and winter, although short, is unstable with snow and temperatures below freezing.

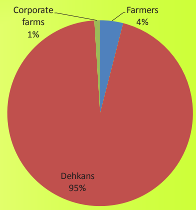
From June to August average afternoon temperatures hit 32°C or higher. The average annual maximum temperature is 40°C in June. Most rain falls in March and April. The summer furnace of 35°C days lasts 40 days from mid-July to the end of August. The frost of winter lasts 40 days from Christmas to the first week of February.

Soil Diversity of soil forming rocks, ecological regimes, vegetation, extreme continental climate, and vastness of the territory contribute to great diversity and complexity of soil cover in the republic . The expansion of a particular soil variant type in Uzbekistan is attributed to natural-zonal features. Thus on most plains with continental climate a desert type of soil prevails, while on contemporary river plains with their favorable soil moisture. The soil cover of foothills and mountain ranges slightly differs from that of plains and has other irregularities.

FARM STRUCTURE

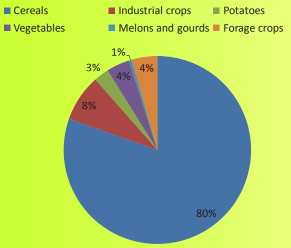
The process of transition to a market economy that began in independent Uzbekistan after 1992 led to the creation of three types of farms: the traditional household plots were renamed **dehkan** farms; the large-scale collective and former state farms were reclassified as **shirkats**; and a new category of midsized **peasant farms** or "farmers".





CROP PRODUCTION

Cropping structure



Yields

Crop	t/ha
Wheat	4,28
Corn	10,24
Rice	5,88
Fruit trees, grapes	9,13
Vegetables	9,73

ANIMAL PRODUCTION

Livestock numbers in farming entities for 2008-2011 (thousand head)

	2008	2009	2010	2011
Cattle	7912	8046	8210	8416
- cows	3283	3327	3416	2530
Sheep and goats	13064	13523	14432	14600
Poultry	27947	31447	32500	33000
Horses	170	175	180	185
Pigs	99	99	100	102

Uzbekistan is the 6th largest producer and the 2nd largest exporter of cotton in the world. With annual production of about 1 million ton of fiber (4%-5% of world production), 10% of world exports of cotton.

The most important agricultural products in Uzbekistan, in addition to cotton are fruits, vegetables and grains (wheat, rice and corn).

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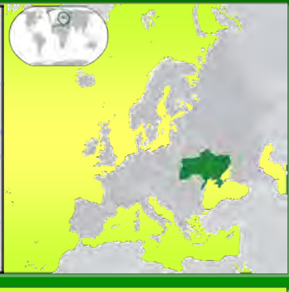
19th International Farm Management Congress
21-26 July 2013, Warsaw, Poland

AGRICULTURE IN UKRAINE

Tetiana Voitushenko, Victoriia Slobodeniuk
Warsaw University of Life Sciences

Country *– 603 628 km²*
Population *– 44 854 065*
In urban areas – 66%
In rural areas – 33%
Agricultural land area *– 412920 km²*
Arable land – 56.1%
Permanent grassland – 1.6%
Employed in agriculture – 15,8%
Share of agriculture in GDP *– 9%*



NATURAL CONDITIONS

Ukraine is the world's 44th-largest country (after the Central African Republic, before Madagascar). It is the largest wholly European country and the second largest country in Europe (after the European part of Russia, before metropolitan France).[i][30] It lies between latitudes 44° and 53° N, and longitudes 22° and 41° E.

Ukraine has a mostly temperate continental climate, although the southern Crimean coast has a humid subtropical climate.[116] Precipitation is disproportionately distributed; it is highest in the west and north and lowest in the east and southeast. Winters vary from cool along the Black Sea to cold farther inland. Average annual temperatures range from 5.5 °C (41.9 °F)–7 °C (44.6 °F) in the north, to 11 °C (51.8 °F)–13 °C (55.4 °F) in the south.

Significant natural resources in Ukraine include iron ore, coal, manganese, natural gas, oil, salt, sulfur, graphite, titanium, magnesium, kaolin, nickel, mercury, timber and an abundance of arable land.

Despite this, the country faces a number of major environmental issues such as inadequate supplies of potable water; air and water pollution and deforestation, as well as radiation contamination in the north-east from the 1986 accident at the Chernobyl Nuclear Power Plant. Recycling toxic household waste is still in its infancy in Ukraine.

FARM STRUCTURE

Land of former collective farms was distributed among its members. Each member received "share" (or plot) of land that varied in size depending on the region. Average share size is 4 ha (or about 9-10 acres)

Currently there is a land sales ban (moratorium), so owners of land plots can not legally sell them.

The main method of agricultural land distribution is rent. Farmers and agricultural companies rent land from multiple plot owners

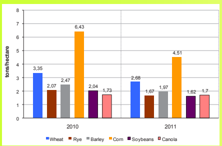
NUMBER OF PRIVATE FARMS BY REGIONS IN UKRAINE

AVERAGE SIZE OF PRIVATE FARMS BY REGIONS IN UKRAINE, HA

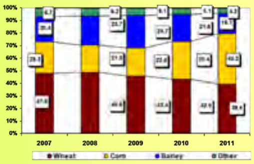
CROP PRODUCTION

•*Ukraine consumes about 25-26 million tons of grain per year and the remaining part is exported.*
•It is expected that total grain **exports will increase due to large beginning stocks** and absence of grain

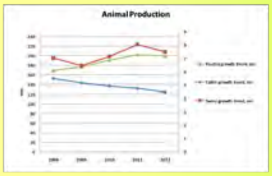
YIELDS OF MAJOR CROPS IN UKRAINE (TONS/HECTARE)



CHANGES IN PRODUCTION STRUCTURE OF GRAIN CROPS IN UKRAINE (% of total crop)



ANIMAL PRODUCTION

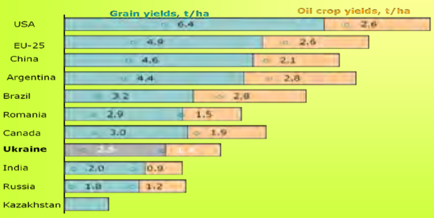


Cattle growth trend, mn				
2008	2009	2010	2011	2012
5,49	5,15	4,92	4,74	4,47

Swine growth trend, mn				
2008	2009	2010	2011	2012
7,02	6,44	7,14	8,04	7,48

Poultry growth trend, mn				
2008	2009	2010	2011	2012
169,3	176,6	190,5	202,1	199,5

YEILD COMPARISONS ACROSS COUNTRIES



Source: UNDP reports

WHY UKRAINE IS WELL POSITIONED TO MEET ITS OWN AND INTERNATIONAL FOOD DEMAND?

1. *Location near major consumer markets (Russia, Central Europe, Western Europe)*
2. *A country with vast arable land potential, mostly high quality soils.*
3. *Potential to double total grain production to 80-100 million tons.*

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