Understanding Producer Strategies:

Identifying Key Success Factors of Commercial Farms in 2013

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Abstract:

Farm management is a series of complex processes incorporating a variety of dynamic factors, including biological aspects, resource allocation and management, and the management of increasingly complex financial/economic systems, which managers are constantly asked to prioritize and allocate management effort amongst. This work determines which success factors, from five predetermined factors (managing production; managing land, equipment, and facilities; controlling costs; managing output prices; and managing people) commercial producers identified as most important for the success of their operation. A total of 28.6 % of respondents selected controlling costs and 27.3% selected managing production as most important factors. From producer-specific estimates of a mixed logit model, correlations between the success factors were estimated; the strongest correlation observed was the negative relationship between managing production and controlling costs. Implications for self-identified success factors of commercial agricultural producers are far reaching, potentially influencing sales, marketing, and decision support for these operations, as well as driving research and programmatic focus to provide relevant information to these producers moving forward.

Introduction

Successful farm management is the culmination of simultaneous management of a variety of dynamic processes, including biological processes, human resource management, resource allocation and management, and the management of increasingly complex financial/economic systems. Arguably, the scarcest resource for any manager, whether in agricultural pursuits or otherwise, is time. Thus, managers are faced with the constant need to prioritize tasks and make

tradeoffs among tasks. This begs the question: Amongst commercial farmer managers, are certain management factors consistently chosen above others as being key to their success?

The necessity to make decision tradeoffs extends beyond farmers, or producers, to include consumers making shopping or purchasing decisions. The study of preferences for food and production attributes has been mostly applied to consumer issues, however many of the decisions made in food production, including those decisions made on-farm involve various actors, of which farmers are a very integral part. Methods traditionally used in consumer-focused research have been adapted to better understand the preferences of producers, in particular willingness to change, which incorporates the concepts of willingness to pay and willingness to accept for process changes by producers (Schulz and Tonsor, 2010, Ortega et al. 2014). Roucan-Kane et al. (2013) used choice experiments to study agribusiness executives and their behavior and preferences when selecting innovation projects. The removal of production technology, specifically rbST, was studied by Olynk, Wolf, and Tonsor (2012) by using choice experiments to estimate changes in producer welfare under various production technology option sets. Lusk and Briggeman (2009) identified a set of food values and found a significant relationship between consumers' value system and their stated and revealed preferences. Erdem, Rigby, and Wossink (2012) examined two groups of stakeholders' perceptions of the share of overall responsibility at each stage of the food supply chain in ensuring that the meat people cook and eat at home is safe using best-worst scaling, namely farmers and consumers. They found that farmers tend to think that consumers have a greater degree of responsibility than consumers believe they have for themselves.

The goal of this research is to determine how large farm managers in the United States make tradeoffs between the key factors they believe make their operations successful.

Furthermore, this paper evaluates the relative importance of these factors. Lastly, this research analyzes the relationships between the key success factors and the producers' demographics and farm-specific characteristics in order to predict the importance of each of the key success factors to the varying types of large farming operations throughout the United States. The objectives of this paper will be to (i) identify the key success factors of large farming operations in the U.S., (ii) determine how large producers perceive the importance of each of these factors in comparison to each other, and (iii) analyze the relationship between these key success factors and producer and enterprise characteristics.

Data and Methods

The data used in this analysis was obtained from the 2013 Large Commercial Producer Survey, which is conducted every 5 years by the Center for Food and Agricultural Business at Purdue University. The survey asks questions to determine buying behaviors, loyalty to brands and dealers, demographic information, and key operational success factors of commercial producers in the industry. The producers targeted in this survey are those with more than $100,000 in gross farm sales. A total of 2,247 respondents participated in the 2013 survey, via phone, mail, and internet, and completed the choice question employed in this analysis[1].

A choice question was developed to obtain information from U.S. farmers regarding their management efforts amongst key factors of success. Specifically, the key success factors investigated were: managing production; managing land, equipment, and facilities; controlling costs; managing output prices; and managing people. An experiment using best-worst scaling was used to assess farmer preferences for and tradeoffs among the success factors. Best-worst

[1] Infogroup of Papillion, NE collected the survey results. Their proprietary database was used to target and contact survey respondents.

scaling is rooted in random utility theory, a well-studied and tested theory of human decision making generalized by McFadden (1974). Best-worst scaling has been revealed in recent years to have advantages over other revealed preference methods, including the use of relative tradeoffs (Flynn et al, 2007; Lusk and Briggeman, 2009). In this study U.S. farmers were shown a pair of success factors and were asked to select which they felt was most (best) and the least (worst) important to them. Given the pairwise nature of the experimental design used, farmers selected only the most important factor, leaving the least important factor to be implied (the one not selected). This task was repeated ten times per farmer. The question presented to survey respondents is presented in Figure 1. Given the structure of the series of paired success factors, each factor could have been selected by an individual respondent a minimum of zero times and a maximum of four times. Farmers' responses to these choice tasks were used to measure each attribute's position on a continuum of importance (Lusk and Briggeman, 2009).

The choice task presented included a total of 5 success factors (J) for analysis, $J=5$, therefore a total of $J*(J-1)=20$ possible best-worst combinations could have been chosen by the survey participant. Assigning λ_j to represent the location of the success factor j on the scale of importance, the latent unobservable level of importance for the producer i is,

$$I_{ij} = \lambda_i + \varepsilon_{ij}$$

where ε_{ij} is a random error term. The probability that the farmer selects item j and item k as the best and worst, respectively, is the probability that the difference in I_{ij} and I_{ik} is greater than all other $J*(J-1)-1$ possible differences in the choice set. Following Lusk and Briggeman (2009), if the error term is an independently and identically distributed type I extreme value, the probability takes the multinomial logit form of,

$$\text{Prob (j = best } \cap \text{ k = worst)} = \frac{e^{\lambda_j - \lambda_k}}{\sum_{l=1}^{J}\sum_{m=1}^{J} e^{\lambda_l - \lambda_m} - J}$$

The parameter λ_j can then be estimated with maximum likelihood estimation and represents the importance of value-attribute *j* relative to the attribute ranked least important (identified ex-post), normalized to zero, to avoid the "dummy variable trap" (Lusk and Briggeman, 2009). The random parameters logit (RPL) also known as a mixed logit model was estimated as specified in Lusk and Briggeman (2009) in order to explore preference heterogeneity amongst farmer respondents for the key success factors studied. In order to obtain results consistent with standardized ratio scaling techniques, the share of importance (*S*) for each success factor, equal to the forecasted probability of being chosen as most important (best), can be calculated as

$$S_j = \frac{e^{\lambda_j}}{\sum_{k=1}^{J} e^{\lambda_k}} \ .$$

The preference shares for all value attributes must sum to one across all 5 success factors investigated. In addition to mean preference shares for the entire sample, individual-specific shares were estimated (through the estimation of individual-specific coefficients from the random parameters logit model), enabling the analysis of correlations between an individual's preference shares for the five key success factors and key farm demographics, enterprise types, or farmer-specific demographics, such as age, education, and gender.

Results & Discussion

A total of 2,247 respondents completed the survey and choice question used in this analysis, resulting in a total of 21,218 total individual choices having been made. Demographics and summary statistics describing the survey respondent, and the operation they represent, are presented in Table 1. 83% of respondents were male and the largest percentages of respondents

were between 40 and 69 years of age. 86% of respondents were reportedly the "primary farm decision maker," while ten percent indicated they were the spouse of the primary decision maker. A total of 62% of respondents were from the Midwest region, while 17% were farming in the South and West, and 4% in the Northeast. In addition to general farm demographics, the specific type of enterprises operated were of interest; Table 2 displays the percent of total respondents who reported operating dairy, hog, beef, corn/soybean, wheat, cotton, and fruit, nut, or vegetable enterprises. In general, the mean size of the enterprises from the survey is much larger than the average across the U.S. This is because the survey sampling process targeted larger farms, especially those with more than $100,000 in gross farm sales.

Results from the multinomial logit (MNL)and RPL analysis (Table 3) show that producers, on average, emphasize the factors of controlling costs and managing production, compared to managing land, equipment, and facilities; managing people; and managing output prices, for farm success. Because the specific factor's utility parameters from the MNL and RPL models have no interpretations on its own, derived preference shares for each of the factors were also calculated and are presented in Table 3. From the MNL model, results show 26.2% of producers selected controlling cost as most important. Meanwhile, nearly 25.8% selected managing production and 21.0% selected managing land, equipment, and facilities. From the RPL model, 28.6% selected controlling costs and 27.3% selected productions, slightly more than the MNL model. The RPL model estimated lower share preferences of producers selecting managing land, equipment, and facilities, output prices, and managing people than the MNL model.

From the producer specific estimates of the RPL model, correlations between the successes factors were estimated (Table 4). All of the correlations were significant at the 95%

confidence level or higher. The strongest correlation observed was the negative relationship between managing production and controlling costs (-0.607). These two factors were earlier identified (Table 3) as those which producers were most likely to select as success factors.

Other strong correlations observed were between controlling costs and managing land, equipment, and facilities (-0.441), and controlling costs and managing people (-0.478). It was also observed that the success factor of managing output prices had a negative correlation with all other success factors.

Additionally, corrections between those specific RPL model estimates for success factors and farm demographics and producers' demographics were completed. Table 5 reports the Pearson Correlation and Spearman Rank Correlation for the success factors and livestock enterprise sizes. Overall, more significant correlations were observed with the Spearman Rank Correlation method. With both correlation methods, however, many livestock size characteristics were significant and positively correlated with managing people. This highlights a general tradeoff of larger livestock producers to place more emphasis on managing production and less on controlling costs. It should also be noted that livestock enterprise sizes were consistently positively correlated with managing production and negatively correlated with for controlling costs. This illustrates a generalized tradeoff of livestock producers who are larger to place more emphasis on managing production and less on controlling costs.

The Pearson and Spearman Correlations for success factors and crop enterprise acreage are reported in Table 6. The results for corn and soybean acreage are nearly identical for both correlation measures. Significant and positive correlations were observed for managing production and managing people, while a significant and negative correlation was observed for controlling costs.

For wheat and barley acreage, only one significant correlation was observed. The Spearman method reported a 0.062 correlation significant at the 90% level for managing production and additional acreage. Cotton acreage had no significant correlations for either correlation measure.

The Pearson method found a significance between potato acreage and managing land, equipment, and facilities, but the Spearman method found significant correlations for managing production (positive), output prices (negative), and managing people (positive).

Both Spearman and Pearson methods found positive and significant correlation between tomato acreage and managing production, output prices, and managing people and a negative, significant correlation with controlling costs. Furthermore, the Spearman method found a negative and significant correlation for tomato acreage and managing land, equipment, and facilities; reporting that all factors were significant to tomato acreage.

For other fruit and vegetable acreage, the only significant correlation observed was a negative correlation for acreage and managing production with the Pearson method. This is the only significant negative correlation for managing production with any enterprise units, including livestock.

A final correlation matrix between the individual producers' RPL estimates for each factor and producer demographics is reported in Table 7. Both the Pearson and Spearman methods reported a positive and significant correlation for education level and managing production, output prices, and managing people. Both methods also report a negative, significant correlation between education and controlling costs while the Spearman methods also found a negative, significant correlation for managing land, equipment, and facilities. The Spearman methods reported significance for education across all success factors.

Results from the Person correlation analysis indicated male respondents to be less likely to select managing people as important to the success of their operation.

Positive and significant correlations for managing land, equipment, and facilities; output prices; and controlling costs were observed for both correlation measure. A negative and significant correlation was also observed for managing production with both methods.

When considering gross farm sales, our analysis suggests that larger farms are more likely to select managing production and managing people as most important and less likely to choose managing land, equipment, and facilities and controlling costs.

Conclusion

The implications from this research are important for commercial agricultural producers. While a producer's success is likely a combination of each of these factors, it is important for producers to consider the factors that create success for their operation and compare these factors, or benchmark, to other producers with similar characteristics. While our research in no way can prove causation, in practice, producers can consider these results in light of their current situation and the goals that they set forth for their farm.

Future research of interest is to link the commercial producer's success factors with other behavior factors of a farm, such as their buying preference and loyalty. This research will link these success factors to other components of the producer's business model and provide input suppliers insights into producer buying behavior. Any additional survey work in this area should carefully consider the shortcomings of this work. First, the scope of producer success was limited to the five factors evaluated. It is possible that factors outside of this research's scope would be significant. Additionally, the measure of success was left open-ended for the respondents to

interpret. It is possible that respondents had different measures of success for their different operations such as gross margin, return on equity, or even passing a family tradition to the next generation. Finally, insufficient data was collected for regional comparison to evaluate if geographic differences created significant differences.

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Table 1. Respondent Demographics

Demographic Variable	Percent (%) of Respondents
Male	83
Age	
18-24	0
25-39	5
40-54	27
55-69	46
70+	22
Education	
Attended H.S.	3
H.S. Graduate	31
Graduate of two-year college	18
Some four-year college	11
B.S.	29
M.S.	5
Advanced Grad Work	3
Role of Respondent	
Primary farm decision maker	86
Spouse of primary farm decision maker	10
Other family employee	3
Other non-family employee	1
% of respondents with farm income between	
Less than $100,000	15
$100,000-$499,999	34
$500,000-$999,999	18
$1,000,000-$2,499,999	19
$2,500,000-$4,999,999	8
$5,000,000 and over	6
Region	
Northeast	4
South	17
Midwest	62
West	17

Table 2. Farm Enterprise Summary Statistics

Variable	Percent (%)of Farms Reporting this Enterprise	Mean Enterprise Size [1] (Standard Deviation)
Enterprises Represented		
Dairy Enterprise	13	560 cows (1,030)
Hog Enterprise	3	26,065 hogs (63,612)
Beef Enterprise	8	1,679 cows (2,775)
Corn/Soy Bean Enterprise	41	1,481 acres (1,511)
Wheat Enterprise	9	2,240 acres (2,082)
Cotton Enterprises	3	1,219 acres (1,844)
Fruit, Nut, and Vegetable Enterprises	11	932 acres (2,162)

[1] Only those farms reporting the enterprise units (acreage or head) are included in enterprise summary statistics.

Table 3. Multinomial Logit and Random Parameters Logit Results and Derived Preference Shares

Value	Econometric Estimates			Shares of Preferences	
	MNL	RPL		MNL	RPL
		Coefficient	Standard Deviation		
Production	0.832* (0.017)	1.049* (0.025)	0.486* (0.029)	0.258	0.273
Land, Equipment, and Facilities	0.625* (0.016)	0.771* (0.223)	0.474* (0.028)	0.210	0.207
Controlling Costs	0.846* (0.017)	1.095* (0.028)	0.673* (0.030)	0.262	0.286
Output Prices	0.335* (0.016)	0.369* (0.023)	0.651* (0.028)	0.157	0.138
People	0.000	0.000		0.112	0.096

Note: Individuals were shown 10 choices each, although not all respondents completed all 10 choices. Thus, the total number of respondents included in the econometric estimates was 2,247 but a total of 21,218 choices were made, rather than the 22,470 that were presented.

Table 4. Correlations among Shares of Preferences of Producer Success Factors

Pearson Correlations										
Value	Managing Land, Equipment, Facilities		Managing Production		Controlling Cost		Output Prices		Managing People	
LEF			-0.046	**	-0.441	***	-0.271	***	0.308	***
Production	-0.046	**			-0.607	***	-0.233	***	0.268	***
Controlling Costs	-0.441	***	-0.607	***			-0.308	***	-0.478	***
Output Prices	-0.271	***	-0.233	***	-0.308	***			-0.106	***
Managing People	0.308	***	0.268	***	-0.478	***	-0.106	***		

Note: Statistical significance at the 10%, 5%, and 1% level is represented by *,**, and ***, respectively.

Table 5. Correlations between Shares of Preferences for Producer Success Factors and Livestock Enterprise Head

Pearson Correlations										
Value	Managing Land, Equipment, Facilities		Managing Production		Output Prices		Controlling Costs		Managing People	
Dairy Cows	-0.031		0.058		.009		-0.090		0.311	***
Finished Hogs	-0.066		0.162	**	-.037		-0.078		0.087	
Feeder Pigs	-0.071		0.095		-.070		-0.015		0.147	**
Finished Cattle	0.088	*	0.062		-.054		-0.089	*	0.118	**
Feeder/Stock Cattle	0.055		-0.040		.082	*	-0.078	*	0.141	***
Custom Cattle Fed	0.103		0.076		-.032		-0.121	*	0.105	*
Custom Heifers Fed	-0.005		0.080		-.064		-0.058		0.196	***
Spearman Rank Correlation										
Dairy Cows	0.013		0.100	**	-.162	***	-0.075		0.339	***
Finished Hogs	-0.018		0.104	*	.003		-0.076		0.102	*
Feeder Pigs	-0.126	*	0.196	***	-.021		-0.097		0.168	**
Finished Cattle	0.067		0.007		.019		-0.061		0.052	
Feeder/Stock Cattle	0.201	***	0.084		-.135	**	-0.149	**	0.148	**
Custom Cattle Fed	0.249	***	0.007		-.065		-0.113	*	0.118	*
Custom Heifers Fed	0.002		0.152	***	-.041		-0.104	***	0.104	***

Note: Statistical significance at the 10%, 5%, and 1% level is represented by *,**, and ***, respectively.

Table 6. Correlations between Shares of Preferences for Producer Success Factors and Crop Enterprise Acre

Pearson Correlations										
Value	Managing Land, Equipment, Facilities		Managing Production		Output Prices		Controlling Costs		Managing People	
Corn	-0.029		0.130	***	-0.027		-0.082	***	0.151	***
Soybeans	-0.019		0.141	***	0.006		-0.113	***	0.129	***
Wheat, Barley, Other Small Grains	-0.036		0.040		-0.008		0.002		-0.037	
Cotton	-0.029		0.008		-0.064		0.049		0.032	
Potatoes	-0.094	*	0.002		0.026		0.032		0.047	
Tomatoes	-0.028		0.054	**	0.067	***	-0.084	***	0.101	***
Other fruits and vegetables	-0.003		-0.012		0.008		0.013		-0.048	**
Spearman Rank Correlation										
Corn	0.002		0.152	***	-0.041		-0.104	***	0.104	***
Soybeans	-0.006		0.133	***	0.010		-0.109	***	0.083	***
Wheat, Barley, Other Small Grains	-0.019		0.062	*	-0.001		-0.052		0.027	
Cotton	-0.068		-0.014		-0.063		0.042		0.030	
Potatoes	0.049		0.112	**	-0.134	***	-0.062		0.155	***
Tomatoes	-0.042	*	0.053	**	0.044	**	-0.087	***	0.088	***
Other fruits and vegetables	-0.003		-0.008		0.023		0.008		-0.030	

Note: Statistical significance at the 10%, 5%, and 1% level is represented by *,**, and ***, respectively.

Table 7. Correlations between Shares of Preferences for Producer Success Factors and Producer Demographics

Pearson Correlations										
Value	Managing Land, Equipment, Facilities		Managing Production		Output Prices		Controlling Costs		Managing People	
Education	-0.028		0.054	**	0.067	***	-0.084	***	0.101	***
Gender	-0.003		-0.012		0.008		0.013		-0.048	**
Age	0.067	***	-0.118	***	0.045	**	0.027		-0.050	**
Gross Farm Sales	-0.051	**	0.152	***	-0.004		-0.125	***	0.275	***
Spearman Rank Correlation										
Education	-0.042	*	0.053	**	0.044	**	-0.087	***	0.088	***
Gender	-0.003		-0.008		0.023		0.008		-0.030	
Age	0.071	***	-0.106	***	0.072	***	0.030		-0.014	
Gross Farm Sales	-0.056	**	0.170	***	-0.038	**	-0.125	***	-0.188	***

Note: Statistical significance at the 10%, 5%, and 1% level is represented by *,**, and ***, respectively.

Figure 1. Best-Worst Question as Presented to Farmer Survey Respondents

Which of the following pairs is most important to your success as a farmer? (*check one box for each pair*)

□	Managing Land, Equipment, and Facilities	*or*	□	Output Prices
□	Managing Production	*or*	□	Output Prices
□	Output Prices	*or*	□	Managing People
□	Controlling Costs	*or*	□	Managing Land, Equipment, and Facilities
□	Output Prices	*or*	□	Controlling Costs
□	Managing Land, Equipment, and Facilities	*or*	□	Managing Production
□	Managing Production	*or*	□	Controlling Costs
□	Managing People	*or*	□	Managing Land, Equipment, and Facilities
□	Controlling Costs	*or*	□	Managing People
□	Managing People	*or*	□	Managing Production