Goal Structure of U.S. Grass-Fed Beef Producers

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Abstract

The objectives of this study are to determine which goals are considered most important by U.S. grass-fed beef producers and to evaluate the drivers impacting producer goals. The goals "maintain and conserve land" and "produce healthy beef" were the most important goals while "increase farm size" was the least important.

Key Words: Goal structure, grass-fed beef, fuzzy pair-wise

Introduction

In recent years, demand for grass-fed beef has risen rapidly. Some of the reasons for this growth relate to the health and environmental benefits associated with beef raised exclusively on pasture and forage. Concerns over antibiotic use, animal rights, and use of growth promotants have boosted the demand for grass-fed beef (Lusk and Fox, 2003; Spiselman, 2006). Media and other social networks have promoted consumer awareness and the importance of healthy meat. Beef consumers are becoming more concerned about how their food is raised than ever before. This has provided a potential niche market for alternative beef products. Beef products from production systems that promote best management practices consistent with environmental conservation and healthy food are thriving and commanding a larger market share.

Consumers associate three major potential benefit areas with grass-fed beef: health and nutrition, animal welfare, and ecosystem friendly farming practices (Crosson et al., 2006; McCluskey et al., 2005). Health and environmental concerns have caused/induced an increase in the demand for naturally produced beef from alternative production systems. Twenty-three percent of beef consumers were willing to pay a premium of $1.36 per pound of grass-fed beef (Umberger et al., 2002). Some beef producers have tried to modify their production systems to

obtain the desired attributes in the beef they produce. An increased proportion of forage in cattle diets relative to grain significantly improves the fatty acids profile and contents of vitamin E (Ferrel et al., 2006; Simmone et al., 1996).

Choice of a beef operation to undertake depends largely upon the interests or goals of producers as well as the available resources such as land, labor, capital, pasture, etc. Most studies conducted in agricultural economics have focused on profit maximization and/or cost minimization as the important considerations for a farming enterprise. While they are important considerations, profit maximization and cost minimization are not the only goals that producers consider in their decision making (Kliebenstein et al., 1980). Producer goals are generally multi-dimensional rather than uni-dimensional (Smith & Capstick, 1976; Patrick et al., 1983). The concept of maximizing producer's utility rather than simply profit is an important concept in understanding producer preferences.

This study investigates eight important goals for the U.S. grass-fed beef producer. Grass-fed beef is a niche market product defined by very specific characteristics. Producers in this market segment therefore tend to capitalize on these attributes in promoting or expanding their farming enterprise. For instance, "producing health beef"—one goal addressed in the study—could be the goal of a producer; likewise, "having time for other activities" could be another goal for the same producer. Estimation of the weights attached to each and every potential goal listed/identified by a producer is the goal of this study. The satisfaction that a producer obtains from achieving a goal is "utility". Producing healthy beef may have more weight in a producer's utility function, but some other goals such as maximizing profit or having time for other activities may be important, as well.

Method Used to Elicit Goal Hierarchies

To determine the importance placed by producers on different goals, different approaches have been utilized to elicit goal hierarchies. Major methods that have been widely used include the basic pair-wise comparisons, magnitude estimation, the analytic hierarchy process, and the fuzzy pair-wise comparison (Harper and Eastman, 1980; Van Kooten et al., 1986; Patrick et al., 1983; Datta et al., 1992; Kim et al., 1999; Spriggs and Van Kooten, 1983; Ells et al., 1997; Mendoza and Sprouse, 1989: Boender et al., 1989).

The basic pair-wise comparison requires a respondent to make a mutually exclusive decision—where all other goals are dropped but one. Under this method, no two goals can be selected as being equally important. This is a major limitation with this method. Respondents make an "all-or-nothing" decision for each paired comparison (Van Kooten et al., 1986)—only one goal can be selected at a time. With magnitude estimation, an arbitrary weight is assigned to a standard goal. The respondent is then required to make a decision between the standard goal and other potential goals (Patrick et al., 1983). The analytic hierarchy process uses a modified pair-wise comparison approach to determine the relative importance between goals. Pairs of goals are provided to respondents on a calibrated Likert type of scale with each goal positioned at the edge of the scale. The respondent is required to place a mark on the scale at the point representing his or her level of preference. Between the two goals at the midpoint on the scale is a neutral point of indifference. Respondents who are indifferent between the two goals can chose this point. Scales used can range from "absolutely important", at the edges representing the two different goals, to "equal" or "neutral", at the center of the scale.

This study uses the fuzzy pair-wise approach which is similar to the analytical hierarchical process in design but different when it comes to the scaling or ranking of goals

compared. This method does not require respondents to select a specific discrete scale assigned to a level of importance such as “Absolutely Important” but allows them to mark a point as an uncalibrated distance between the two goals as shown below to represent their level of preference.

Maximize profit --**X**----------I---------- Produce healthy beef.

In the above example, the goal “Maximize profit” is much more important than “produce healthy beef” for the producer in question. Point “I” represents the point of indifference where both goals are equally important. The closer a mark is to a goal, the more important that goal is relative to the paired goal. Another advantage of using this approach is that it uses the entire set of goals in generating the scale value of each goal.

Data and Methods

The data used in this study are from a 2013 mail survey of U.S. grass-fed beef producers. A survey package containing a personally addressed and signed cover letter, a ten-page questionnaire, and a postage-paid return envelope was mailed to a total of 1,052 U.S. grass-fed beef producers. Extensive search of the Internet provided the names and addresses of grass-fed beef producers contacted for the survey. Among the Internet sources were the eatwild.com, Market Maker, and a listing of producers with the American Grass-fed Association. Two sets of questionnaires and two postcard reminders were sent to the sampled grass-fed beef producers for a return rate of 41.1% (384 usable surveys were received).

A definition of grass-fed beef was provided at the beginning of the questionnaire to ensure that responses from only grass-fed beef producers were obtained. Following the definition were questions regarding the farm and farmer characteristics. Relevant to this study was the question addressing the goal structure of the farm. A survey question was provided with a brief

description as follows: “Grass-fed beef producers may have a number of goals with respect to their operations. Below are some potential goals that you may have for your farm operation. Some goals are likely to be more important to you than others. In this section, you will be asked to compare each of eight goals with each of the other goals. We are interested in how important each goal is to you when compared to the other goals.” The goals were: produce healthy beef, maintain and conserve land, have family involved in agriculture, have time for other activities, avoid years of loss/low profit, increase net worth, maximize profit, and increase farm size. An example of pair-wise comparison is provided below using the “Maximize profit” and “Produce healthy beef” paired goals.

Pair A: Maximize profit --**X** ----------I---------- Produce healthy beef.

Pair B: Maximize profit ----------I--**X**---------- Produce healthy beef.

Pair C: Maximize profit **X**----------I---------- Produce healthy beef.

Pair D: Maximize profit ----------**X**---------- Produce healthy beef.

The respondent is asked to mark an “X” on the dotted line to indicate his or her preference. A goal with the shortest distance to the mark is preferred to the other. For Pair A, the goal “maximize profit” is much more important than the goal “produce heathy beef”. On the other hand, Pair B illustrates a producer who considers producing healthy beef being a slightly more important goal than maximizing profit. Pair C represents absolute preference for the goal “Maximize profit”. Pair D represents a case where the respondent weighs both goals equally.

Let the goal “Maximize profit” be represented by letter “A” and the goal “Produce healthy beef” by letter “B”. The level of preference of A over B, R_{AB} is measured by the distance from mark “X” to B. Considering the total distance between A and B to equals 1, if $R_{AB} < 0.5$, then B is preferred to A; if $R_{AB} = 0.5$ then A is indifferent to B; if $R_{AB} > 0.5$, then A is preferred

to B. In the case of absolute preference for alternative A, R_{AB} takes the value of 1, 0 otherwise. If we have a total of *M* goals, then the total number of pair-wise comparisons, *K*, is calculated as $K = M * (M - 1)/2$ (Van Kooten et al., 1986).

Each paired comparison denoted as R_{ij} for $(i \neq j)$ is obtained, where $R_{ji} = 1 - R_{ij}$. An individual's fuzzy preference matrix can thus be constructed as follows (Van Kooten et al., 1986)

$$R = \begin{bmatrix} 0 & r_{12} & r_{13} & . & . & . & r_{1j} \\ r_{21} & 0 & . & . & . & . & r_{2j} \\ r_{31} & . & 0 & . & . & . & r_{3j} \\ . & . & . & 0 & . & . & . \\ . & . & . & . & 0 & . & . \\ . & . & . & . & . & 0 & r_{(i-1)j} \\ r_{i1} & r_{i2} & . & . & . & r_{i(j-1)} & 0 \end{bmatrix}$$

where each element of the matrix represents the magnitude of the preference for a given goal, *i*, relative to another goal, *j*. The intensity of goal *j*, I_j, ranges between 0 and 1 and can be calculated using the following formula:

$$I_j = 1 - \left(\sum_{i=1}^{n} R_{ij}^2 / (n-1) \right)^{1/2}$$

The higher the value of I_j, the higher the intensity of preference for the particular goal. From the values of the I_js, grass-fed beef producer preferences for each of the eight goals is estimated using a logistic seemingly unrelated regression model. The effects of the farm and farmer characteristics are estimated using a logistic regression model. The following linearized logistic model is estimated (Gujarati, 1995)

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_i X_i + e_i$$

where P_i is the weight of a particular goal computed from the fuzzy preference matrix and $1 - P_i$ is the total weight of the remaining goals.

Potential Drivers of Goal Hierarchy

The following farm and farmer characteristics are considered as potential drivers of goal hierarchy. *Cow-calf* is a dummy variable indicating whether or not the respondent produced weaned calves, *Years_Opr* is the total number of years operating grass-fed beef enterprise, *Totalacrs* is the total number of hectares on the farm, *Totcattle* is the total number of cattle raised on the farm, *Enterprs* is the total number of enterprises operated on the farm alongside the grass-fed beef enterprise, *D_Aratio* refers to debt-to-asset ratio of the farm (an indicator of a farm's financial status), *Age* is the age of the producer, *Postcollege* is a dummy variable indicating whether or not the farmer held a 4-yr college degree, and *Offfarm_job* is a dummy variable indicating whether or not the respondent held an off-farm job. Regional variables included: *MW, NE, SE, NW,* and *SW,* indicating the farm was located in the Midwest, Northeast, Southeast, Northwest, or Southwest region of the U.S.

Results and Discussion

Summary statistics of the explanatory variables (the potential drivers) used is provided in Table 1. Eighty percent of the respondents were involved in the cow-calf segment. Producers had an average of eleven years of experience operating the grass-fed beef enterprise. The mean operated hectares was 337 with a larger standard deviation of 891, indicating the existence of a larger variation in the size of land operated across the responding population. The average number of animals raised on the farm was 127. Significant variation is evidenced by the larger standard deviation, 890.50, of *Totcattle* in Table 1. On average, respondents operated two enterprises alongside grass-fed beef. The average age was 55 years with 70% of respondents

having at least a 4-yr college degree. The Midwest region of the U.S. had a relatively larger share of the respondents, accounting about 30% of the total respondent population. Northeast followed with 21%. Following the Northeast were the Southeast and Northwest representing 17% each.

Table 1. Summary Statistics of Farm and Farmer Characteristics

Variables	Variable Definition	Mean	SD
Cowcalf	Cow-calf (1 if cow-calf, 0 otherwise)	0.80	0.40
Years_Opr	Number of years operating grass-fed beef	11.36	8.10
Totalacrs	Farm size in Hectares	336.64	890.50
Totcattle	Total number of animals	126.78	371.69
Enterprs	Number of other farm enterprises operated	1.73	1.59
D_Aratio	Debt asset ratio	1.30	0.54
Age	Age	54.66	13.73
Postcollege	Education level (1 if 4-yr degree, 0 otherwise)	0.70	0.49
Offfarm_job	Off-farm job (1 if yes, 0 otherwise)	0.69	0.46
MW	MW (1 if Midwest, 0 otherwise)	0.30	0.47
NE	NE (1 if Northeast, 0 otherwise)	0.21	0.41
SE	SE (1 if Southeast, 0 otherwise)	0.17	0.34
NW	NW (1 if Northwest, 0 otherwise)	0.17	0.38
SW	SW (1 if Southwest, 0 otherwise)	0.15	0.28

Table 2 provides summary statistics of the eight goals solicited in the study. The goals Maintain and Conserve Land and Produce Healthy Beef appeared as the most important goals with goal scores of 0.148. Have Time for Other Activities followed with mean value of 0.139. Have Family Involved in Agriculture, Avoid Years of Loss/Low Profit, Increase Net Worth, Maximize Profit, and Increase Farm Size followed in that order, with mean values of 0.136, 0.133, 0.110, 0.108, and 0.077, respectively. Increase Farm Size was the least important goal.

Table 2. Summary Statistics of Important goals of U.S. grass-fed beef Producers

Goals	Mean Score	Standard Deviation
Maintain and conserve land	0.148	0.032
Produce healthy beef	0.148	0.031
Have time for other activities	0.139	0.031
Have family involved in agriculture	0.136	0.043
Avoid years of loss/low profit	0.133	0.032
Increase net worth	0.110	0.031
Maximize profit	0.108	0.034
Increase farm size	0.077	0.035

To fully evaluate producers' decisions to operate a grass-fed beef enterprise, a question asking producers to rate seven listed reasons for choosing grass-fed beef enterprise (over other enterprises) was provided. Producers were asked the following question: "To what extent do you agree or disagree that your selection of a grass-fed beef enterprise as opposed to other potential farm enterprises is because of the following reasons? Please rate each reason on the scale provided below." Table 3 provides the summarized results for this question. Most producers were in strong agreement that they wanted to produce healthy beef and that is the reason why they selected the grass-fed beef enterprise over other potential farm enterprises. Following closely is the reason that producing grass-fed beef is good for the environment with a mean of 4.66. Consistent with the goal scores obtained in the preceding section—results presented in Table 2 – health and environmental reasons appear to be the most important factors influencing producers' decisions to produce grass-fed beef.

Table 3. Reasons for Selecting a Grass-fed Beef (GBF) Enterprise

Reasons	**Mean**	**Standard Deviation**
I want to produce health beef	4.792	0.633
Producing GFB It is good for the environment	4.664	0.774
Producing GFB is enjoyable	4.615	0.713
GFB systems are more sustainable than those of grain-fed beef	4.604	0.827
There is strong demand for GFB in my area	4.386	0.857
Raising GFB is good for my family	4.276	0.898
GFB production is more profitable	4.138	0.905
I have ample land suitable for grazing	4.055	1.101
Producing GFB is low-cost	3.643	1.159

To identify potential drivers influencing producer goal preferences, a seemingly unrelated regression (SUR) model was run using the set of explanatory variables represented in Table 1. The use of SUR was motivated by the fact that it increases efficiency in estimation by combining information on different equations (Moon and Perron, 2006). It is most likely for the error terms to be contemporaneously correlated for a series of equations sharing the same set of explanatory

variables. Ordinary least squares (OLS) estimates are obtained while ignoring the correlation between the error terms of different equations (Cadavez and Henningsen, 2012). The SUR therefore leads to efficient parameter estimates (Yahya et al., 2008).

Before executing the SUR, variance inflation factors (VIF) were estimated to check if any multicollinearity existed. All VIF values obtained were less than 10. As a rule of thumb, this was a clear indication that there was no serious correlation between the independent variables used. White's and the Breusch-Pagan/Godfrey tests were used to check for heteroscedasticity, which was also not found.

Results in Table 4 indicate that cow-calf producers were more concerned with producing healthy beef and less concerned with having time for other activities. Larger-scale (in terms of land size) producers were less concerned with producing healthy beef but more concerned with having family involved in agriculture. Likewise, having a larger herd on the farm negatively impacted the goal of producing healthy beef but positively impacted the economic-related goals of avoiding years of losses, increasing net worth and maximizing profits. Older grass-fed beef producers were more likely to be concerned with maintaining and conserving land, producing healthy beef, and avoiding years of loss / low profit, but less likely to be concerned about having time for other activities and having family involved in agriculture. Grass-fed beef producers holding a 4-yr degree were more likely to be concerned about having time for other activities.

Table 4. Results from the Seemingly Unrelated Regression of the Goal Scores

Variables	Maintain and conserve land	Produce healthy beef	Have time for other activities	Have family involved in agriculture	Avoid years of loss	Increase net worth	Maximize profit	Increase farm size
Cowcalf	0.080	1.050**	-0.959**	0.664	-0.596	0.358	-0.659	0.062
	(0.454)	(0.430)	(0.417)	(0.587)	(0.436)	(0.447)	(0.474)	(0.511)
Years_Opr	0.015	0.003	0.008	0.038	-0.044**	-0.036*	-0.004	0.020
	(0.023)	(0.021)	(0.021)	(0.029)	(0.022)	(0.022)	(0.024)	(0.025)
Totalacrs	-0.652	-1.232**	0.349	1.697**	0.731	-0.151	0.277	-1.019
	(0.672)	(0.636)	(0.617)	(0.868)	(0.645)	(0.661)	(0.701)	(0.756)
Totcattle	-0.001	-0.004***	-0.002**	0.001	0.002*	0.002**	0.003***	0.013
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.021)
Enterprs	-0.045	0.149	-0.266**	0.171	0.045	0.018	-0.048	-0.024
	(0.114)	(0.108)	(0.105)	(0.148)	(0.110)	(0.113)	(0.119)	(0.129)
D_Aratio	-0.398	-0.068	0.143	0.709**	0.102	-0.086	-0.242	-0.161
	(0.324)	(0.307)	(0.297)	(0.418)	(0.310)	(0.318)	(0.338)	(0.364)
Age	0.030**	0.039***	-0.018*	-0.064***	0.029**	0.001	-0.011	-0.006
	(0.014)	(0.013)	(0.013)	(0.018)	(0.014)	(0.014)	(0.015)	(0.016)
Postcollege	-0.105	-0.405	0.543*	-0.028	-0.416	0.542	0.220	-0.352
	(0.390)	(0.370)	(0.359)	(0.504)	(0.374)	(0.384)	(0.407)	(0.439)
Offfarm_job	-0.280	0.318	-0.274	-0.089	0.088	0.300	0.040	-0.101
	(0.370)	(0.350)	(0.340)	(0.478)	(0.355)	(0.364)	(0.386)	(0.416)
NE	0.372	-0.608	0.450	-0.408	0.507	-0.194	-0.326	0.207
	(0.476)	(0.451)	(0.437)	(0.615)	(0.457)	(0.468)	(0.497)	(0.535)
SE	0.019	0.143	-1.560***	-0.584	0.400	-0.264	1.294**	0.551
	(0.553)	(0.524)	(0.508)	(0.715)	(0.531)	(0.544)	(0.578)	(0.622)
NW	-0.111	-0.013	-1.348***	-0.238	0.921**	-0.236	0.592	0.433
	(0.509)	(0.482)	(0.468)	(0.658)	(0.488)	(0.501)	(0.531)	(0.572)
SW	0.889	1.262*	-0.073	0.118	2.181***	-0.872	-0.379	1.237
	(0.794)	(0.753)	(0.730)		(0.762)	(0.781)	(0.829)	(0.893)

Conclusions

Results from this study indicate some heterogeneity in goal preference. A general summary of the eight goals indicated Maintain and Conserve Land, Produce Healthy Beef, Have Time for Other Activities, Have Family Involved in Agriculture, Avoid Years of Loss/Low Profit, Increase Net Worth, Maximize Profit, and Increase Farm Size as the order of preference, starting with the most preferred to the least preferred goal. This, however, cannot reveal the potential drivers associated with such ranking. Results from the SUR model helped to identify these potential drivers—the main source of heterogeneity in goal preference.

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