Analysis of Site-Specific Determinants of Location Decisions
for the U.S. Broiler Industry

by

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Abstract

A national survey of broiler industry executives is conducted to analyze site-specific factors related to the broiler-complex location problem. Conjoint analysis is used to measure the relative importance of each attribute in the location decision. Distance between feed mill and growers, cost of feed ingredients, and community attitude toward broiler industry are found to be the most important factors influencing the location decision of broiler growing, feed mill, and broiler processing respectively. Results from bridging design indicate that cost of feed ingredients is the most important attribute affecting the location of a broiler complex.

Background:

The U. S. poultry industry is the world's largest producer and exporter of poultry meat. There are approximately 200 poultry processing plants in the United States, employing around 250,000 workers (National Interfaith Committee for Worker Justice). Poultry production in the U.S. continues to increase. In 1960, the average American consumed 63.3 pounds of beef, 59.1 pounds of pork, and 34.3 pounds of poultry (23.6 pounds of broilers). In 2001, per capita consumption was 66.2 pounds of beef, 53 pounds of pork, and 97.7 pounds of poultry (78.3 pounds of broilers) (USDA and ERS). The broiler industry in the U. S. is vertically integrated. This type of production system is highly efficient and this is the main reason for the success of broiler industry. The broilers are produced and marketed by the firms which own or control breeder flocks, hatcheries, broiler flocks, feed mills, processing plants, further processing plants, transportation and distribution centers. In some cases, an individual independent grower builds chicken houses, and is responsible for land, labor, houses, litter, equipment, taxes, utilities, and insurance for growing broilers. The integrator provides technical assistance, baby chicks, feed and medications. The integrator also catches and transports the birds to processing plants and to final market.

At present, poultry production is concentrated in the southeastern United States. Nine of the top ten poultry-producing states are located in the southeast. The U.S. Census Bureau data for poultry slaughtering and processing indicates that Arkansas occupies first place with 44 slaughtering & processing establishments, followed by Georgia with 42 establishments in the year 1999. Other leading poultry producing states include Alabama, Mississippi, North Carolina, Texas, and Virginia. Even though poultry production is the largest animal industry in these Southern states, poultry operations remain low in other southeastern states (e.g., Florida, Louisiana, South Carolina, and Tennessee). The reason some states are better able to attract poultry processing compared to other states in spite of high growth and demand for broilers is not well understood.

Several factors determine the location of an industry. For instance, the location of a particular food processing industry may depend largely on transportation costs. When it is difficult to transport raw materials, the plant may be located near the source of the farm product. On the other hand, when it is relatively more difficult to transport the processed output, the plant may be located near the final market (Kohls and Uhl). Likewise, in order to lower their total cost of production, processing firms that utilizes primarily unskilled labor tend to locate in regions with high unemployment and a low wage rate. Apart from the above mentioned attributes there are other attributes like, utility cost, cost of inputs, access to markets, environmental regulations, state and fiscal policies etc., affecting the location decision of a processing plant. Determining the relative importance of each attribute and their trade-offs will aid in finding appropriate sites for broiler industry location.

Literature Review

A few studies have addressed factors affecting the location decision of the broiler industry. Easterling, Braschler and Kuehn conducted a study on optimal location of the U.S. broiler industry. They found that energy cost had relatively low importance in determining the location of the broiler industry. They also found that the southern producing regions, especially Georgia and Alabama had a substantial cost advantage in broiler production, processing and distribution. According to them the need to import feed in addition to that produced locally is the most critical factor for broiler production in the South.

Lopez and Henderson examined the determinants of location choices of new food processing plants in the Mid-Atlantic region using the results of a telephone survey. The sample included fruit and vegetable, egg, poultry and seafood processors. They performed 56 telephone interviews of which 4 were related to poultry processing. Out of the 41 factors surveyed, the factors considered most critical for poultry industry location decision were; water waste disposal cost, availability of waste treatment/disposal facility, water pollution regulations, availability of an existing plant facility, stringency of enforcement of environmental regulation, and capital expenditure for pollution abatement. The results also showed that labor factors, and state and local policies are relatively less important in the location decision of a poultry company (Lopez and Henderson).

Aho analyzed the regional trends in broiler production. In his study he analyzed the trends involved in the location of new broiler complexes. During the period of 1996-1998, seven new complexes were established in the U.S., of which 3 were established in Kentucky, and one each in Tennessee, Texas, Oklahoma, and Alabama (Aho). According to his findings, high feed cost, high land and labor cost, and high cost of production (especially transportation cost) are the main disadvantages for broiler industry location in the North, Midwest, and West respectively. He attributed inexpensive land and labor, favorable business climate, and inexpensive transportation cost (cheap rail rates) as the main advantages for broiler industry location in the South. Kentucky is the fastest growing area in broiler production in the U.S. with close to 5% of total U.S. broiler production (Aho). Kentucky has the advantages of Midwest in terms of feed costs, and proximity to Midwestern markets without the labor, and regulatory disincentives of the Midwestern states (Aho). Berry analyzed the factors involved in the site selection for new and modified poultry facilities for the state of Oklahoma. His study showed that, the availability of utilities (availability and quality of water, electricity, and natural gas) is the most important factor considered during the site selection.

This study differs from previous studies in that a more comprehensive set of location factors will be studied. Moreover, the methodology used in the present study will allow for measuring the relative importance of each attribute that affects the location decision. The objectives of the study are to: 1) identify factors affecting the site locations of poultry complexes in the United States, and 2) measure the effects and relative importance of these factors on the poultry complex location decision.

Methodology

Conjoint analysis (CA) is a methodology useful in distinguishing the relative importance of attributes that influence multidimensional decision making (Green and Wind). It provides a means to decompose the overall preferences for a particular site location into partial effects associated with selected attribute levels. The specific steps involved in conjoint analysis are: 1) selection of relevant attributes and levels, 2) construction of conjoint design and survey method to collect the data, and 3) choosing an appropriate model to analyze and estimate the respondent's partworth utilities.

Selection of Attributes and Levels

The selection of attributes for the location problem of a broiler complex is based upon prior studies related to broiler industry location, group discussions, and personal interviews with broiler industry experts. The key enterprises of a broiler complex are broiler production, feed production, and broiler processing. Each enterprise is associated with numerous factors affecting the location decision. Therefore, three conjoint designs were developed for this study. The broiler growing conjoint design includes six attributes with two levels per attribute. The Feed mill design includes three attributes, one attribute with three levels and two attributes with two levels each, and the broiler processing design includes seven attributes, each with two levels. All three conjoint designs have one attribute (community attitude toward broiler industry) in common. Broiler growing and broiler processing conjoints have three attributes in common. The common attributes will be utilized to bridge the three conjoints. Table 1 lists the attributes and levels for the three conjoints. A Bridged design is applied to reduce the information overload on respondents by dividing the location features into two or more separate designs. The two designs will have some features in common, which are later used to bridge the two designs (Albaum). To bridge two designs there must be one attribute in common called the bridging attribute, which is used to scale the partworths from the two sub designs to arrive at an overall set of partworths. The bridging attribute should be represented in similar fashion in all the sub designs (Albaum). A few studies have utilized the Bretton-Clark's Bridger software to analyze a large number of attributes. This study applies a technique similar to that applied by Francois and MacLachlan, which they call a "Symbridge design".

After selecting the attributes and levels they must be combined to form hypothetical location sites, which are evaluated by respondents. The experimental design in this study utilizes a full-profile approach. The full-profile approach utilizes the complete set of attributes. A problem with the full-profile approach is the possibility of information overload on part of the respondent (Green and Srinivasn, 1978). However, the full profile approach is expected to be superior in terms of pragmatic description of stimuli and predictive validity (Green and Srinivasn, 1978). Using a full factorial design for this study would require a large number of location profiles. Since there are six attributes with two levels each in the broiler growing conjoint design, there are 2x2x2x2x2x2= 64 possible broiler growing locations. Similarly, for feed mill there are 3x2x2=12 possible locations. In case of broiler processing, there are seven attributes with two levels each, making 2x2x2x2x2x2x2= 128 possible broiler processing locations. These combinations can be termed as location features for which the respondent gives a rating or ranking. Researchers commonly use fractional factorial designs to overcome the problem of large numbers of profiles. This design is used to show a limited number of location features while accounting for all attributes and levels. The software utilized for this study is Conjoint Designer Version 2 by Bretton-Clark. Conjoint Designer produces a series of location profiles based on the specification of attribute and its levels. In this study, Conjoint Designer produced eight location profiles for each of the three conjoint. Each profile represents a possible location for broiler growing, feed mill, and broiler processing.

The Survey

A questionnaire was constructed to elicit the preferences for each of the eight location features for each conjoint. Respondents were asked to rate each profile on a scale of 0 (least preferred) to 10 (most preferred). The survey was administered to the Chief Executive Officers (CEOs) of 43 broiler companies in the U.S. The survey was conducted from September to December 2002. Complete responses were received from 9 CEOs of broiler companies, for a response rate of 20.9 percent.

Summary of Sample Characteristics

The respondents all together were operating 72 broiler complexes in the U.S. Around 44% of the respondents have their oldest broiler complex established more than 40 years back. About 44% of the respondents expanded their poultry operations by building a new broiler complex in the last 5 years. Around 33% of the respondents employ more than 10,000 workers in their broiler operations and have sales of more than $1 billion in the last fiscal year. Approximately 66% of the respondents are planning to expand their broiler operations in the next 5 years. Most of the respondents planning to expand prefer to expand an existing complex (adding growers, feed mills, and processing plant), or build a further processing facility that adds value to ready-to-cook products. None of the respondents prefer to build a new broiler complex in the next five years. Most of the respondents indicated growth of domestic market and expansion of market share as the primary forces driving the expansion of their broiler operations.

Model Specification

In conjoint measurement, the total preference for a location is assumed to be a function of the attributes part- worth values. A two-limit Tobit model is used to estimate attributes partworths based on respondent's preference rating for the location features. The two-limit Tobit model is specified as follows:

$$U_{ij}^{*} = \beta X + \varepsilon_{ij},$$

$$Pref_{ij} = \begin{cases} 0 \text{ if } U_{ij}^{*} \leq 0, \\ U_{ij}^{*} \text{ if } 0 < Uij^{*} < 10, \\ 10 \text{ if } 10 \leq U_{ij}^{*} \end{cases}$$

where U_{ij}^{*} represents *ith* respondents unobservable utility for a particular combination of location attribute levels for enterprise *j*, $Pref_{ij}$ *is* the observed rating scale of respondent *i* for a particular combination of location attribute levels for enterprise *j*, **β** is a row vector of part-worth and marginal utility effects, ***X*** *is* a column vector of location attributes, and ε_{ij} is the error term.

The attribute vector **X** for the broiler growing enterprise contains a series of dummy variables defined as follows: X_1 = 1 or -1 represents water cost of $2.50 per thousand gallons and $1.00 per thousand gallons, respectively; X_2 = 1 or -1 represents heating cost of $1.00 per gallon and $0.90 per gallon, respectively;X_3 = 1 or -1 represents electricity cost of 6.50 cents per kWh and 4.00 cents per kWh, respectively; X_4 = 1 or -1 represents 250-300 and 75-100 number of growers and potential growers available, respectively; X_5= 1 or -1 represents 30 miles and 100 miles distance between feed mill and grower, respectively; X_6= 1 or -1 represents favorable and not favorable community attitude toward broiler industry, respectively.

The attribute vector **X** for the feed mill enterprise contains a series of dummy variables defined as follows: X_7 = 1 and X_8 =0 represents $ 160.00 per ton feed ingredient cost; X_7 = 0 and X_8 =1 represents $ 260.00 per ton feed ingredient cost; X_7 = -1 and X_8 =-1 represents $ 310.00 per ton feed ingredient cost; X_9 = 1 or -1 represents good and poor quality of roads from feed mill to growers, respectively; X_{10} = 1 or -1 represent favorable and not favorable community attitude toward broiler industry, respectively.

The attribute vector **X** for broiler processing enterprise contains a series of dummy variables defined as follows: X_{11} = 1 or -1 represents water cost of $2.50 per thousand gallons and $1.00 per thousand gallons, respectively; X_{12} = 1 or -1 represents electricity cost of 6.50 cents per kWh and 4.00 cents per kWh, respectively; X_{13} = 1 or -1 represents 400 miles and 800 miles proximity to major metropolitan markets, respectively; X_{14}= 1 or -1 represents high and low unemployment rate in the region, respectively; X_{15} = 1 or -1 represents $8.50 per hour and $7.50 per hour average hourly wage in the region , respectively; X_{16} = 1 or -1 represents sewer cost $3.00 per thousand gallons and $1.00 per thousand gallons, respectively; X_{17} = 1 or -1 represents favorable and not favorable community attitude toward broiler industry, respectively.

Results:

The estimated part-worth utilities for selected attribute levels for broiler growing enterprise are presented in table2. The log-likelihood χ^2 statistics is significant for broiler growing design indicating that the part-worth estimates are jointly different from zero. Most of the coefficients associated with the attributes have appropriate signs. The coefficients associated with the distance between feed mill and growers and community attitude toward broiler industry are significant at the 0.05 percent level of confidence. The electricity cost, which has the expected sign, is significant at the 0.10 percent level. The coefficients associated with heating cost, water cost and number of growers and potential growers available are not significant.

Distance between feed mill and growers is the most important attribute associated with locations of broiler growers. The coefficient is positive indicating that as the distance between feed mill and growers increases the respondent's preference for a particular grower's location decreases (0.3477 for 30 miles and -0.3477 for 100 miles), which is consistent with economic theory. Since integrators provide feed for the chicks, they prefer growers located close to the feed mill in order to reduce transportation costs. Community attitude toward the broiler industry is also found to be an important factor in broiler growing. The broiler companies prefer to locate in a region where the community attitude is favorable to the broiler industry.

The insignificant result for water cost, heating cost, and electricity cost may be attributed to the fact that integrators are not responsible to pay utility costs under contract broiler production. As mentioned earlier, the company provides technical assistance, baby chicks, feed and medications to the growers, and on the other hand grower builds chicken houses, and is responsible for land, labor, houses, litter, equipment, taxes, utilities, and insurance for growing broilers. These are the predominately used contracts within the industry.

The relative importance of each attribute is calculated using the method described by Harrison et al., (page166). The relative importances of the attributes in broiler growing are presented in table2. The distance between feed mill and growers accounted to 28.75% of the difference in preference scores. This finding is not surprising given that broiler companies' transport feed to broiler houses twice in five days, which indicates that companies prefer short distance between feed mill and growers, thus reducing the transportation cost. Community attitude toward broiler industry is the second important factor contributing around 23% to the preference rating for a broiler growing location. Water cost is found to be the least important factor from the respondent's point of view. Respondents also considered electricity cost to be more important than number of growers in their location decision.

The estimated part-worth utilities for selected attribute levels for feed mill enterprise are presented in table2. The log-likelihood χ^2 statistics is significant for feed mill enterprise indicating that the part-worth estimates are jointly different from zero. The coefficients associated with the attributes have appropriate sign and are found to be significant at the 1% level. Cost of feed ingredients is found to be the most important factor in the location decision of a feed mill.

The coefficient for the lowest cost of feed ingredients ($160.00 per ton) is positive (4.845) and the coefficient for the medium cost of feed ingredients ($26.00 per ton) is negative (-1.925), which indicates that as the cost of the feed ingredients increases the preference for that location decreases; (coefficient for the highest cost of feed ingredient ($310.00) further decreases to -2.92) this trend is consistent with economic theory. Quality of roads between feed mill and growers, and community attitude toward broiler industry are also found to be important in the feed mill location decision. All the attributes are found to be significant at the 1% level.

The relative importances of attributes in the feed mill location are presented in table 2. As expected, the cost of feed ingredients is found to be the most important attribute accounting around 59% to the preference rating for feed mill location. This result is consistent with the fact that cost of feed ingredients is one of the major costs of broiler production. The companies tend to locate broiler complexes at regions where the feed cost is low. Following feed cost, community attitude toward broiler industry is the second most important factor, accounting for 24.5% of preference rating. Even though quality of roads is the least preferred attribute, it accounts for 16% of preference rating. The broiler companies prefer to have good quality of roads between feed mill and growers, to reduce the cost of transportation.

The estimated part-worth utilities for selected attribute levels for broiler processing conjoint design are presented in table 3. The log-likelihood χ^2 statistics is significant for broiler processing design indicating that the part-worth estimates are jointly different from zero. The coefficients of all attribute levels have the correct sign. Most of the coefficients associated with attributes are found to be significant at the 1 % level. Exceptions include the electricity cost and sewer cost, which have the expected sign, and are significant at the 5% level. The coefficients for water cost and proximity to major metropolitan markets are not significant.

Community attitude toward broiler industry is found to be the most important factor in the location decision of broiler processing plant. The broiler companies prefer to have a favorable community attitude toward broiler industry. This result is consistent with the fact that broiler firms face problems from the residents as it eliminates a huge amount of solid waste and wastewater into the surrounding areas creating some environmental concerns.

Unemployment rate in the region is also found to be one of the most important factors. Broiler companies prefer to locate their processing plant in a region where the unemployment rate is high. This indicates availability of large number of low-skilled workers. Average hourly wage in the region is also found to be critical in the location decision of broiler processing plant. The coefficient is negative indicating a decrease in utility when wage increases (-0.914 for a wage of $8.50 per hour and 0.914 for a wage of $7.50 per hour), which is consistent with previous studies. The concentration of broiler complexes in the South may be attributed to the above two attributes related to labor. The coefficients associated with electricity cost, sewer cost, water cost have negative signs indicating that they have negative impact on broiler processing plant location decision

The relative importances of attributes in broiler processing plant location decision are presented in table 3. Results indicate that community attitude is found to be the most important attribute accounting for around 30% of the preference rating. Following community attitude, labor factors are found to be the second and third most important attributes, each accounting for 18% of preference rating. Proximity to major metropolitan markets is found to be the least preferred attribute, accounting for 3.5% of preference rating. The reason for this can be attributed to increasing local demand and per capita consumption of chicken.

Bridging Estimates

This study applied the bridging design similar to that employed by Francois and MacLachlan. Since bridging can be done for two designs at a time, broiler growing and broiler processing conjoints are bridged initially and the resulting design is bridged with the feed mill conjoint design to get the final overall partworths.

The bridging factor used to bridge the broiler growing and processing conjoint is calculated as follows,

$$B = \frac{(R_{11} + R_{12} + R_{13})}{(R_{21} + R_{22} + R_{23})}$$

where, B= bridging scalar; R_{ij} *= range of partworths of bridging attribute j in subdesign i.*

As there are three factors in common between broiler growing and broiler processing conjoints, the partworth ranges of these attributes (water cost, electricity cost, and community attitude toward broiler industry) are utilized to calculate the bridging factor. To solve the nonsymmetry problem, B is applied to rescale the broiler processing conjoint design partworths, and B^{-1} is applied to rescale the broiler growing conjoint design partworths. The algorithm applied for this study was as follows:

Stage 1	Stage 2	Final Part- Worths
P_2	$P_2 * B^{-1}$	$P_2 + (P_2 * B^{-1})$
P_4	$P_4 * B^{-1}$	$P_4 + (P_4 * B^{-1})$
P_5	$P_5 * B^{-1}$	$P_5 + (P_5 * B^{-1})$
$P_{11} * B$	$P_1 * B^{-1}$	$(P_{11} * B) + (P_1 * B^{-1})$
$P_{12} * B$	$P_3 * B^{-1}$	$(P_{12} * B) + (P_3 * B^{-1})$
$P_{17} * B$	$P_6 * B^{-1}$	$(P_{17} * B) + (P_6 * B^{-1})$
$P_{13} * B$	P_{13}	$(P_{13} * B) + P_{13}$
$P_{14} * B$	P_{14}	$(P_{14} * B) + P_{14}$
$P_{15} * B$	P_{15}	$(P_{15} * B) + P_{15}$
$P_{16} * B$	P_{16}	$(P_{16} * B) + P_{16}$

where, P_2, P_4, P_5, P_{13}, P_{14}, P_{15}, *and* P_{16}, are the partworth estimates for heating cost, number of growers and potential growers available, distance between feed mill and growers, proximity to major metropolitan markets, unemployment rate in the region, average hourly wage in the region, and sewer cost respectively. P_1, P_3, P_6, and P_{11}, P_{12}, P_{17} are the part-worth estimates of water cost, electricity cost, and community attitude towards broiler industry for broiler growing and broiler processing, respectively. These three are the common attributes between the two conjoints.

Table 4 presents the overall partworths and relative importance of attributes obtained by bridging the two conjoints. The results show that distance between feed mill and grower is the most important attribute accounting for 19% of the preference rating. Community attitude toward the broiler industry is the second most important attribute, contributing around 17% to the preference rating. Proximity to major metropolitan markets is found to be the least important factor contributing only 2.3% to the preference rating.

After bridging broiler growing and broiler processing conjoint, the next step is to bridge the new design (broiler growing + broiler processing) with the feed mill conjoint. In this step there is only one common attribute (community attitude toward broiler industry) between the two designs. The part-worth range of this attribute from the two designs is used to calculate the bridging factor.

The bridging scalar is calculated as follows:

$$BF = \frac{R_{11}}{R_{21}}$$ *BF= bridging scalar; R_{ij} = range of partworths for bridging attribute j in subdesign i.*

To solve the nonsymmetry problem, the factor BF was applied to rescale the new design (broiler growing + broiler processing) partworths and BF^{-1} to rescale the feed mill conjoint design partworths. The algorithm applied for this study was as follows,

$Stage 1$	$Stage 2$	$Final - Partworths$
W_1	$W_1 * BF^{-1}$	$W_1 + (W_1 * BF^{-1})$
W_3	$W_3 * BF^{-1}$	$W_3 + (W_3 * BF^{-1})$
W_4	$W_4 * BF^{-1}$	$W_4 + (W_4 * BF^{-1})$
W_5	$W_5 * BF^{-1}$	$W_5 + (W_5 * BF^{-1})$
W_6	$W_6 * BF^{-1}$	$W_6 + (W_6 * BF^{-1})$
W_7	$W_7 * BF^{-1}$	$W_7 + (W_7 * BF^{-1})$
W_8	$W_8 * BF^{-1}$	$W_8 + (W_8 * BF^{-1})$
W_9	$W_9 * BF^{-1}$	$W_9 + (W_9 * BF^{-1})$
W_{10}	$W_{10} * BF^{-1}$	$W_{10} + (W_{10} * BF^{-1})$
$P_{10} * BF$	$W_2 * BF^{-1}$	$(P_{10} * B) + (W_2 * BF^{-1})$
$P_7 * BF$	P_7	$(P_7 * B) + P_7$
$P_8 * BF$	P_8	$(P_8 * B) + P_8$
$P_9 * BF$	P_9	$(P_9 * B) + P_9$

where, *BF* is the bridging factor, and W_1, W_2, W_3, W_4, W_5, W_6, W_7, W_8, W_9, and W_{10}, represent the part-worth estimates (obtained by bridging broiler growing and processing conjoint designs) of distance between feed mill and grower, community attitude toward broiler industry, unemployment rate in the region, average hourly wage in the region, electricity cost, number of growers and potential growers available, sewer cost, heating cost, water cost, and proximity to major metropolitan market respectively.

Table 5 presents the overall partworths and relative importance of attributes affecting the location of broiler industry. Cost of feed ingredients was found to be the most important factor affecting the location of broiler industry. It accounts for approximately 27% of preference rating for broiler industry location. It can be seen that as the cost of feed increases, the preference for that particular location decreases, (11.441 for $160.00 per ton, -4.538 for $260.00 per ton, -6.903 for $310.00 per ton), which is consistent with economic theory. Distance between feed mill and growers was found to be the second most important factor, accounting for 12.5% of the preference rating. Community attitude toward broiler industry accounted for 11% of the preference rating. Proximity to major metropolitan markets was found to be the least important factor accounting for just 1.5% of the preference rating. Results also show that utility costs are less important in the broiler industry location decision compared to some other factors in the study. Electricity cost was found to be most important among the utility costs accounting for 6.32% of the preference rating.

Summary and Concluding Remarks

This study used conjoint analysis to provide information about the relative importance of different attributes affecting the location decision of a broiler complex. The results of conjoint analysis showed that the cost of feed ingredients is the most important factor affecting the broiler industry location decision. According to the results, the most preferred site for a broiler industry is the one where: cost of feed ingredients is low, growers are located close to the feed mill, favorable community attitude, high unemployment rate, low average wage in the region, good quality of roads between feed mill and growers, and low electricity cost. These are the most important attributes affecting the broiler industry location. These results are consistent with the previous studies on broiler industry location. This study applies a bridging technique to link the factors related to broiler growing, feed mill and broiler processing to estimate the overall relative importance of all the attributes involved in broiler industry location. This study differs from earlier studies in that a more comprehensive set of location factors are studied and the methodology used in the study allowed in measuring the importance of an individual level of an attribute affecting the location decision. The state and local authorities can utilize these results to understand and develop strategies to attract broiler companies in an efficient way.

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Table 1: Attributes Involved in Conjoint Analysis

Attributes	Levels
Broiler Growing Conjoint Attributes	
Water cost	1) High cost, $2.50 per thousand gallons 2) Low cost, $1.00 per thousand gallons
Heating cost	1) High cost, LP gas $1.00 per gallon 2) Low cost, LP gas $0.90 per gallon
Electricity cost	1) High cost, 6.50 cents per kWh 2) Low cost, 4.00 cents per kWh
Number of growers and potential growers available	1) 75-100 2) 250-300
Distance between feed mill and grower	1) 30 miles 2) 100 miles
Community attitude toward broiler industry	1) Favorable 2) Not favorable
Feed Mill Conjoint Attributes	
Cost of feed ingredients	1) $160.00 per ton 2) $260.00 per ton 3) $310.00 per ton
Quality of roads from feed mill to growers	1) Poor 2) Good
Community attitude toward broiler industry	1) Favorable 2) Not favorable
Broiler Processing Conjoint Attributes	
Water cost	1) High cost, $2.50 per thousand gallons 2) Low cost, $1.00 per thousand gallons
Electricity cost	1) High cost, 6.50 cents per kWh 2) Low cost, 4.00 cents per kWh
Proximity to major metropolitan markets	1) 400 miles 2) 800 miles
Unemployment rate in the region	1) High 2) Low
Average hourly wage in the region	1) Low wage, $7.50 per hour 2) High wage, $8.50 per hour
Sewer cost	1) Low cost, $1.00 per thousand gallons 2) High cost, $3.00 per thousand gallons
Community attitude toward broiler industry	1) Not favorable 2) Favorable

Table 2: Two-Limit Tobit Partworth Estimates for Broiler Growing and Feed Mill

Variable	Coefficient	S. Error	b/St.Er.	|P[|Z|>z]|
Broiler Growing Design				
Constant	3.617***	0.3476	10.406	0.0000
Distance between feed mill and grower: 30 miles (28.75)[1]	1.005***	0.3477	2.890	0.0039
Community attitude toward broiler industry: Favorable (22.94)	0.798**	0.3474	2.300	0.0215
Electricity cost: High cost, 6.50 cents per kWh (16.82)	-0.585*	0.3470	-1.686	0.0917
Number of growers and potential growers available: 250-300 (12.59)	0.438	0.3470	1.264	0.2061
Heating cost: High cost, LP gas $1.00 per gallon (10.81)	0.376	0.3472	1.085	0.2779
Water cost: High cost, $2.50 per thousand gallons (8.08)	-0.281	0.3470	-0.811	0.4176
χ^2 LogL: 17.55***				
Feed Mill Design				
Constant	3.607***	0.4176	8.639	0.0000
Cost of Feed Ingredients: $160.00 per ton (59.09)	4.845***	0.6659	7.276	0.0000
Cost of Feed Ingredients: $260.00 per ton (59.09)[2]	-1.925***	0.6155	-3.128	0.0018
Community attitude toward broiler industry: Favorable (24.53)	1.612***	0.4028	4.003	0.0001
Quality of roads from feed mill to growers: Good (16.05)	1.075***	0.3987	2.697	0.0070
χ^2 LogL: 59.41***				

Notes: * = Significant at the 10% level, ** = Significant at the 5% level, *** = Significant at the 1% level
[1] the value in the parenthesis represents the relative importance of the attribute.
[2] because cost of feed ingredients has three levels the relative importance is reported for two levels.

Table 3: Two-Limit Tobit Part-worth Estimates for Broiler Processing

Variable	Coefficient	S. Error	b/St.Er.	|P[|Z|>z]|
Constant	4.557***	0.2779	16.396	0.0000
Community attitude towards broiler industry: Favorable (29.67)[1]	1.497***	0.2791	5.367	0.0000
Unemployment rate in the region: High (18.49)	0.933***	0.2784	3.352	0.0008
Average hourly wage in the region: High wage, $8.50 per hour (18.11)	-0.914***	0.2787	-3.283	0.0010
Sewer cost: High cost, $3.00 per thousand gallons (11.77)	-0.594**	0.2781	-2.138	0.0325
Electricity cost: High cost, 6.50 cents per kWh (11.31)	-0.571**	0.2782	-2.054	0.0400
Water cost: High cost, $2.50 per thousand gallons (7.13)	-0.360	0.2779	-1.296	0.1951
Proximity to major metropolitan markets: 400miles (3.51)	0.177	0.2780	0.638	0.5236
χ^2 LogL: 45.08***				

Notes: *=Significant at the 10% level, ** = Significant at the 5% level, *** = Significant at the 1% level

[1] the value in the parenthesis represents the relative importance of the attribute.

Table 4: Bridging Estimates for Broiler Growing and Processing

Attributes	Part worth	Relative Importance
Distance between feed mill and grower		19.01
30 miles	2.464	
100 miles	-2.464	
Community attitude toward broiler industry		16.92
Favorable	2.196	
Not favorable	-2.196	
Unemployment rate in the region		12.05
High	1.565	
Low	-1.565	
Average hourly wage in the region		11.82
High wage, $8.50 per hour	-1.532	
Low wage, $7.50 per hour	1.532	
Electricity cost		9.58
High Cost, 6.50 cents per kWh	-1.238	
Low Cost, 4.00 cents per kWh	1.238	
Number of growers and potential growers available		8.35
250-300	1.084	
75-100	-1.084	
Sewer cost		7.65
High cost, $3.00 per thousand gallons	-0.993	
Low cost, $1.00 per thousand gallons	0.993	
Heating cost		7.26
High cost, LP gas $1.00 per gallon	0.936	
Low cost, LP gas $0.90 per gallon	-0.936	
Water cost		5.02
High cost, $2.50 per thousand gallons	-0.656	
Low cost, $1.00 per thousand gallons	0.656	
Proximity to major metropolitan markets		2.32
400 miles	0.303	
800 miles	-0.303	

Table 5: Bridging Estimates for Broiler Industry

Attributes	Part -worth	Relative Importance
Cost of feed Ingredients		26.84
$160.00 per ton	11.441	
$260.00 per ton	-4.538	
$360.00 per ton	-6.903	
Distance between feed mill and grower		12.50
30 miles	4.27	
100 miles	-4.27	
Community attitude toward broiler industry		11.12
Favorable	3.806	
Not favorable	-3.806	
Unemployment rate in the region		7.93
High	2.713	
Low	-2.713	
Average hourly wage in the region		7.76
High wage, $8.50 per hour	-2.655	
Low wage, $7.50 per hour	2.655	
Quality of roads between feed mill and grower		7.41
Good	2.529	
Poor	-2.529	
Electricity cost		6.29
High Cost, 6.50 cents per kWh	-2.146	
Low Cost, 4.00 cents per kWh	2.146	
Number of growers and potential growers available		5.50
250-300	1.879	
75-100	-1.879	
Sewer cost		5.03
High cost, $3.00 per thousand gallons	-1.721	
Low cost, $1.00 per thousand gallons	1.721	
Heating cost		4.74
High cost, LP gas $1.00 per gallon	1.623	
Low cost, LP gas $0.90 per gallon	-1.623	
Water cost		3.34
High cost, $2.50 per thousand gallons	-1.366	
Low cost, $1.00 per thousand gallons	1.366	
Proximity to major metropolitan markets		1.52
400 miles	0.525	
800 miles	-0.525	