ESTIMATING WILLINGNESS TO PAY FOR LIVESTOCK INDUSTRY SUPPORT POLICIES TO SOLVE LIVESTOCK'S EXTERNALITY PROBLEMS IN KOREA*

Ji, In-Bae**
Kwon, Oh-Sang***
Song, Woo-Jin****
Kim, Jin-Nyeon*****
Lee, Yong-Geon******

Keywords
livestock production, externality, multifunctionality, WTP, economic valuation, CVM

Abstract
This research examines the externalities of livestock production by classifying them into positive and negative effects and measures the willingness to pay for livestock industry support policy using the CVM. The survey result reveals that 65.4% of the population considers that a positive function of livestock production is more important than its negative function. They are willing to pay 7,495-10,314 won per household every year to expand positive externalities of the livestock production and to reduce its negative externalities. The value of the externalities of livestock production is estimated to be approximately 134.5 - 185.1 billion won.

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* This research is extracted from 「Externality and Policy Measures of Livestock Industry」 (Ji, In-Bae et al. Korea Rural Economic Institute, 2013).

** Senior Research Fellow(corresponding author), Korea Rural Economic Institute. e-mail: jiinbae@krei.re.kr
*** Professor, Seoul National University.
**** Research Fellow, Korea Rural Economic Institute.
***** Researcher, Korea Rural Economic Institute.
****** Researcher, Korea Rural Economic Institute.

I. Introduction

Odors and water pollution caused by animal waste decrease the quality of life and land price. Also the outbreak of livestock diseases seriously damages local economy. Therefore, conflicts in the community due to livestock are increasing. The number of complaints concerning manure odors was rapidly increased during the last 10 years at an annual average increase of 26.5%, from 2,700 cases in 2001 to 7,247 cases in 2010 (Korea Society of Odor Research and Engineering 2011). The outbreak of foot and mouth disease in winter 2010 badly influenced the local economy: for example, many local festivals were canceled (Korea Rural Economic Institute, 2011).

The livestock industry's status has been getting worse because the conflicts in the local communities due to livestock's negative externality have deepened. The government has been intensifying environment regulations to the livestock farming such as setting down livestock breeding restriction areas. The community residents oppose constructions of new livestock facilities as well as the local governments ask farmers for residents' consent to build the facilities.

Despite the negative effect of livestock farming, animal husbandry has multifunctionality such as a stable supply of livestock products, conservation of agricultural lands and rural landscapes, and vitalization of the rural economy. The multifunctionality of livestock production contributes to the local economic growth by providing the tourism features like education and recreation services. One example is Daegwallyeong Samyang Dairy Farm which is based on the livestock and developed as the tourist spot. This farm has both educational and superb natural scenery purposes.

In addition, the demand for multifunctionality of livestock farming is gradually increasing with improving life style due to the income growth of consumers. This trend can be seen clearly in Europe and Japan. Educational activities including mental and physical healing using livestock multifunctionality for urban residents are increasing. More and more, people want to have ranch experiences using the multifunctionality in Korea too.

Like this, the livestock industry has negative and positive aspects. Therefore, both aspects should be considered to evaluate the economic value of livestock farming.

In this study, the livestock industry's externality in Korea is separated

into external economy and external diseconomy, and the willingness to pay for livestock industry support policy to improve the livestock production externalities is measured. Through it, this study aims to propose the policy measures to minimize the negative externality of livestock production and to maximize the positive externality.

II. Literature Review

Many studies estimate the environmental values using various methods such as simple regression, conjoint analysis, hedonic price model, travel cost, and contingent valuation method. However, few studies are focused on the livestock industry's externality (Park 2005; Kim 2004; Yang, B.W. et al. 2011). Park (2005) analyzes how the odor problem from swine farms affects the price of houses using the spatial hedonic model in Weld County, Colorado, USA. Kim (2004) also tries to analyze the effect of the swine facilities on housing price using spatial quantitative analysis of the area of Craven County, North Carolina, USA. These studies focus on the odor problems of swine facilities and choose specific areas to look into the diseconomy of livestock facilities using spatial models.

Yang, B.W. et al. (2011) calculate livestock production's externality with the benefit-cost analysis. The added value of livestock production and opportunity cost of livestock manure treatment are considered as benefits and cost respectively. That is, they use a replacement cost approach to calculate the externality of livestock production. Therefore, in the strict sense, the calculated economic value of externality in their study does not reflect the true externality of livestock production.

This study directly estimates the willingness to pay for livestock industry support policy to improve the livestock production externalities based on consumer theory while previous studies are focused on the arithmetic calculation of the waste treatment costs or reducing cost of manure odor. Additionally, this study considers the positive externality as well as negative externality of livestock production so that it can supply the balanced point of view for the livestock industry. Therefore, this study is the first in the evaluation of the positive externality of the livestock farming as public goods.

III. Methodology

The livestock industry's externality is a kind of public goods, so its value cannot be measured in the market. Therefore, its economic value should be estimated through various non-market value estimation methods. These non-market value estimation methods are categorized into two: Revealed Preference and Stated Preference. In recent years, Experimental Auction, which is a mix of both techniques, is occasionally used.

The revealed preference method, which analyzes consumers' choices made by individuals, is mostly used for comparing the influence of policies on consumer behavior. This method assumes that the consumers' preferences can be revealed by their purchasing habits. For example, in the case of livestock products, consumers will pay more for meat produced under animal welfare than for normally produced meat in a market. Then the price difference becomes consumers' willingness to pay for animal welfare. This method analyzes the willingness to pay for animal welfare of actual consumers' behavior so it is a very reliable way. However, this method has a limitation if you want to derive a comprehensive evaluation like this study, to evaluate the willingness to pay for the enhancement of the overall livestock external economy (multifunctionality) or mitigation of the external diseconomy.

On the other hand, the stated preference method assumes a hypothetical situation which is presented by a questionnaire about public goods, and then respondents choose any action. Finally the responses are used to analyze the benefits of achievements. This method might have a weakness because the presented situation about the public goods is virtual and respondents should fully understand. Moreover, the payment that the respondents should pay is virtual too. That is, the respondents may not pay in reality even though they answer that they would pay any amount of money in the questionnaire. Thus, there is no guarantee the actual behavior matches with the virtual behavior in the survey. In addition, survey respondents may strategically respond to the questionnaire if they know that their responses can influence the policy choice.

The stated preference method has the problems mentioned above. However, when we evaluate a newly constructed facility or business that does not exist yet, the stated preference method is almost the only way. Further, many studies have sufficiently developed various ways to mitigate the expected

problems in this technique. So if it is properly used, relatively reliable results can be obtained. For instance, the U.S. National Oceanic and Atmospheric Administration (NOAA) recognized the validity of Contingent Valuation Method (CVM) which is one of the stated preference methods and was used to calculate the damage of the stranded tanker Exxon Valdez in Alaska in 1989. Therefore, in this study, CVM is used to estimate the economic value of livestock external economy and external diseconomy.

IV. Model

In this study, a dichotomous choice model is used. This model is theoretically and empirically identified that the error is relatively less than other model. This choice method asks that respondents just choose "yes" or "no" to the given amount of money rather than speak the amount of willingness to pay directly. Then the willingness to pay is econometrically analyzed. There are two types in questions: a single bounded model and a double bounded model. The single bounded model asks one question while the double bounded model asks two questions. The latter is preferred to the former because of the statistical efficiency. In this analysis, the double-bounded question method is used. The estimation is tried by both models to increase the reliability of the analysis: single and double bounded models with the individual characteristics and without the individual characteristics.

Willingness to pay for the "Livestock Support Project" means the amount of individuals' satisfaction by the project. This willingness to pay is called as compensating surplus (CS) and is influenced by personal characteristics as well as various unknown random variables. Therefore, all variables need to be included in the model.

If s_j is a vector of an individual j's characteristics such as income and education and e_j is a random variable which is unobservable characteristics, then the j's willingness to pay is $CS_j = \gamma S_j + e_j$. By estimation of the function, γ can be estimated. If it is assumed that e_j has zero mean and symmetric distribution then γs_j can be used as representative values of the willingness to pay.

If t^1 and t^2 are the first and the second presented amount in a survey respectively then the range of willingness to pay can be determined according

to the response as follows.

① 'yes-no': $t^1 \leq CS \leq t^2$
② 'no-yes': $t^1 > CS \geq t^2$
③ 'yes-yes': $CS \geq t^2$
④ 'no-no': $CS < t^1$

In estimation of CVM, the double bounded model uses both the first and the second responses while the single bounded model only uses the first response. The former is statistically efficient because a survey can get two data in one question, but the probability of additional bias can be increased by one more question.

For the single bounded model, a jth individual's function of willingness to pay can be written as $CS_j = \gamma S_j + e_j$. In this case, an individual j's probability in favor of the "livestock support project" is as follows:

$$\Pr(yes) = \Pr(CS_j > t_j) = \Pr(\gamma s_j + e_j > t_j) = \Pr(e_j > t_j - \gamma s_j)$$

If e_j has zero mean and follows a normal distribution, then another random variable, $\frac{e_j}{\sigma}$, also follows a normal distribution. The probability in favor of the presented amount is $\phi(\frac{\gamma s_j}{\sigma} - \frac{1}{\sigma} t_j)$. The likelihood function and parameters can be derived with a maximum likelihood estimate. Through the process, $\frac{1}{\sigma}$ and $-\frac{\gamma}{\sigma}$ can be estimated and the willingness to pay, $\gamma s_j = \frac{\gamma/\sigma}{1/\sigma} s_j$, can be calculated. Additionally, estimated $\frac{r/\sigma}{1/\sigma} s_j$ is a random variable because the estimated γ and σ are random variables. Thus, representative values of willingness to pay can be changed by sample and those have certain distribution. Therefore, in order to derive the representative distribution of willingness to pay, a very large number of simulations should be carried out to extract the values, and then the mean and variance values of the willingness to pay are calculated (Krinsky and Robb 1986).

The double bounded model is divided into two types by estimated models: a bivariate dichotomous choice model (Cameron and Quiggin 1994) and an interval data model (Hanemann et al. 1991). The latter model is used in this study because the interval data model is often superior to the bivariate model in terms of the mean square error of the estimates (Alberini 1995). The jth individual's function of willingness to pay can be written as $CS_j = \gamma s_j + e_j$. However, the regression cannot estimate γ or σ because CS is not observed directly in the double bounded choice questionnaire.

If the response is "yes-yes" in both questions, then $t^2 > t^1$ and the probability can be simplified as $\Pr(\gamma s_j > t^1, \gamma s_j + e_j \geq t^2) = \Pr(\gamma s_j + e_j \geq t^2)$. If the response is "no-no", then $t^1 > t^2$ and the probability can be simplified as $\Pr(\gamma s_j + e_j < t^1, \gamma s_j + e_j < t^2) = \Pr(\gamma s_j + e_j < t^2)$. YY is defined as 1 if the response is "yes-yes" and as 0 if not. If YN, NY, NN also follow the same way, then the jth respondent's likelihood function is as follows.

$$L_j = \Pr(t^2 - \gamma s_j > e_j \geq t^1 - \gamma s_j)^{YN} \times \Pr(\gamma s_j + e_j \geq t^2)^{YY} \times \Pr(\gamma s_j + e_j < t^2)^{NN} \times \Pr(t^1 - \gamma s_j > e_j \geq t^2 - \gamma s_j)^{NY}$$

If it is assumed that the random variable, e, is normally distributed with variance, σ^2, then the above expression can be changed into a likelihood function which can be estimated as follows.

$$L_j = 1 - \phi\left(\frac{t_j^2 - \gamma s_j}{\sigma}\right)^{YY} \times \phi\left(\frac{t_j^2 - \gamma s_j}{\sigma}\right) - \phi\left(\frac{t_j^1 - \gamma s_j}{\sigma}\right)^{YN} \times \phi\left(\frac{t_j^1 - \gamma s_j}{\sigma}\right) - \phi\left(\frac{t_j^2 - \gamma s_j}{\sigma}\right)^{NY} \times \phi\left(\frac{t_j^2 - \gamma s_j}{\sigma}\right)^{NN}$$

V. Survey

The methodology of the NOAA Panel report is applied to fulfill the CVM. The report suggests the guidelines as follows. First, the CVM survey should be done through interviews but a telephone survey interview can be used when the interview is not possible. Second, the CVM should be applied to the possible environmental accidents in the future to determine the amount of damage rather than already occurred environmental accidents. Third, the CVM should use the vote model as question methods. Fourth, the CVM should exactly explain the expected effects of virtual qualitative environmental change. Fifth, the survey questionnaire or interviewer should enlighten the respondents that if respondents pay any amount of money then their income to spend for other goods and services will be reduced. Sixth, the survey questionnaire or interviewer should inform that there are alternative public goods which can substitute the evaluated public goods. Seventh, the interviewer should check out with additional questions whether the respondents understand exactly what they chose, and why they chose it (Arrow et al. 1993).

In this study, the NOAA guidelines are fully reflected for the accurate measurement of willingness to pay. However, an interview survey was replaced with an internet survey to improve the efficiency of research due to time and cost constraints and because there was no internet survey at the time of the NOAA Panel report.

We conduct the survey of 1,000 people who are 20-69 years old householders with monthly income or their spouses. The sample was randomly selected in accordance with the specific characteristics of 2010 Census such as gender, 16 cities/provinces, age, and proportion of the population living in urban/rural areas. This survey is conducted with a structured online questionnaire. The pre-survey is conducted from July 26 to August 6 and the main survey is conducted from August 12 to September 12. The questionnaire is designed so that each page does not go to the next page for a certain amount of time to make respondents familiar with the hypothetical condition and to enhance respondents' understanding of the question.

In the survey, firstly, demographic characteristics are asked, and then the opinions concerning the livestock industry are asked. Then non-market functions are explained. Two sets of cards (one has a positive aspect of livestock

such as good scenery and the other has a dirty farm and environmental pollution of livestock) are shown. After presenting the cards, we asked which one is stronger between positive features of livestock's non-market functions and negative features. The information of the positive and negative non-market functions of the livestock industry is explained once again, and then the willingness to pay a special tax to solve these problems through the government support is asked.

> As you saw in the cards, the livestock industry supplies livestock products and performs the positive and negative non-market functions at the same time. The government support for the livestock industry is essential because livestock farms cannot maintain the positive function and reduce the environmental contamination and disease outbreaks themselves. In addition, the public enjoy the effects of improvement of food security and environmental pollution.
>
> We need to achieve advanced countries' level of the livestock industry by continuing the role for food security and contributing to the local economy, while reducing livestock disease outbreaks and environmental pollution. We want to know if the government collects a special tax to support the livestock industry, how much you are willing to pay for this.
>
> Your household income is limited and this tax will be used only for supporting the livestock industry. Please consider these and respond to the next question.

After explaining the above contents, we ask the willingness to pay a special amount of tax as follows. If the answer is "yes", a doubled amount is asked once again and if the answer is "no", a half of the amount is asked once again.

> Are you willing to pay extra ( ) won every year as a special tax to support the livestock industry for the next five years?

The pre-survey of randomly selected 205 people is conducted to choose presented amounts. The amount of willingness to pay for the "Livestock Support Project" is asked to be written freely in the pre-survey. The top 10% and bottom 10% after removing 0 are proposed as the upper and lower limits. As a result, in the first question, among 2,000 won, 5,000 won, 12,000 won, 25,000 won, 40,000 won, 60,000 won, one is randomly selected and presented to each respondent as the five-year annual payments. In the second question, the double or half amount of the first one depending on the results of the first question is presented.

In this study, the willingness to pay for livestock industry support policy to improve the livestock production externalities including both external economies and external diseconomy is measured. The reasons why both external economy and external diseconomy are estimated together are as follows. First, if the two effects are measured separately, the effect could be overestimated. Second, the positive and negative characteristics and their value-judgement are different, so the comparison of the estimated economic absolute value is meaningless. Consequently, the measured amount of willingness to pay for livestock industry support policy is the economic value of the industry's externality to achieve the level of advanced countries' livestock industry in Korea.

VI. Data

Table 1 shows the respondents' demographic characteristics and awareness of livestock. In the question that asks which function is stronger between positive function (external economy) and negative function (external diseconomy), 654 people (65.4%) answered the positive function is stronger, while 236 people (23.6%) responded the negative function is stronger. 110 people (11.0%) were not sure.

TABLE 1. Respondents' Demographic Characteristics and Awareness of Livestock

	Answer	Frequency	Ratio(%)
Education	Under middle school	14	1.4
	High school	242	24.2
	Diploma	640	64.0
	Graduate school	104	10.4
Occupation	Farmer	9	0.9
	Self-employed	96	9.6
	Sales	46	4.6
	Production/simple worker	117	11.7
	Office job	371	37.1
	Specialized job	110	11.0
	Housewife	216	21.6
	No job	25	2.5
	Etc	10	1.0
Origin	Cities	681	68.1
	Rural areas	319	31.9
Agricultural experience	Yes	490	49.0
	No	510	51.0
Livestock breeding experience	Yes	234	23.4
	No	766	76.6
A family of agricultural workers	Yes	287	28.7
	No	713	71.3
Family size	1	14	1.4
	2	169	16.9
	3	256	25.6
	4	439	43.9
	5	99	9.9
	6	20	2.0
	Over 7	3	0.3
Farm visiting experience	Yes	521	52.1
	No	479	47.9
Awareness of livestock	Positive Function	654	65.4
	Negative Function	236	23.6
	Not sure	110	11.0

The cross-analysis is conducted to look into how the demographic characteristics of the respondents influence their awareness of livestock. The results show that people living in cities and males tend to consider that the positive function of livestock is stronger compared to those who live in rural areas and females. In addition, the younger think the positive function is stronger than the older. However, the rest of the respondents' characteristics have no correlation with the awareness of the livestock industry.

Table 2 shows the ratio of the acceptable amount of payment for the "Livestock Support Project". 59.7% of respondents show positive willingness to pay. When the proposed amount in the first question is high, the acceptance of the respondents for the amount is generally low. These results are compatible with a common perception. On the other hand, the acceptance in the second question is not necessarily low for the higher proposed amount because the answer depends on the first question. However, the probability of "yes" in the second question is higher when a person responds "yes" in the first question than when one responds "no" in the first question.

TABLE 2. The Probability of Acceptance for the Proposed Amounts of Payment

First Question		Second Question	
Amount (Won)	Probability of Acceptance (%)	Amount (Won)	Probability of Acceptance (%)
2,000	58.1	1,000	27.1
		4,000	62.9
5,000	46.7	2,500	24.7
		10,000	53.8
12,000	33.5	6,000	25.2
		24,000	35.7
25,000	26.4	12,500	14.6
		50,000	36.4
40,000	27.7	20,000	16.7
		80,000	37.0
60,000	17.5	30,000	12.4
		120,000	31.0

40.3% of 1,000 respondents show that they have no willingness to pay for the project on neither first nor second questions. The reasons why they are not willing to pay for the project are asked and the results are in table 3. Among the refusal reasons to pay for the project, as for "I cannot afford", "It

should be performed with already paid tax", and "Farmers or people related to livestock must solve problems", their willingness to pay for the project can be considered zero or below the proposed amount in the question. However, if the respondents answered "The project is not my concern", "The meat market should be opened internationally", "The project outcome is not sure", "Cannot trust government's plan", "The information is not enough to decide", then it could be interpreted as refusal or postponement of their decisions or lack of understanding the question. That is, these cases could be interpreted as refusal or lack of understanding the survey. Among the 403 responses of zero willingness to pay, 119 people gave the above five refusal or lack of understanding reasons. Therefore, 119 responses are not included in the analysis because these responses are considered as invalid responses. If these refusal or misunderstanding responses are included in the estimation, the estimation results could be underestimated.

TABLE 3. Refusal Reason of the Project

Refusal Reason		Ratio of total(%)
Zero WTP (284)	I cannot afford	6.2
	It should be performed with already paid tax	14.7
	Farmers or people related to livestock must solve problems	6.9
Refusal or lack of understanding (119)	The project is not my concern	1.3
	The meat market should be opened internationally	0.7
	The project outcome is not sure	2.2
	Cannot trust government's plan	4.2
	The information is not enough to decide	3.5
	etc	0.6
Sum		40.3

VII. Estimation Results

The single and double boundary models with characteristic variables and without them are estimated with 881 samples. The estimating results are in table 4 and table 5. In the models without characteristic variables, the means of WTP per household are 8,425 won in the single boundary model and 10,314 won in the double boundary model. Those estimates without characteristic variables are statistically significant.

TABLE 4. Estimation Results without Characteristic Variables

Variables	Single Model		Double Model	
	Coefficients	t-value	Coefficients	t-value
Constant	0.1528	2.32**	10,314.33	6.72***
Presented amount	-0.000181	-8.15***	-	-
σ	-	-	37,738.9	238.06***
Respondents number	881		881	
lnL	-556.89		-1,285.43	
Mean WTP	8,425		10,314	

Note: ***, **, and * are statistically significant at 1%, 5%, and 10% respectively.

In the models with characteristic variables, the means of WTP per household are 7,495 won in the single boundary model and 9,368 won in the double boundary model. As for the estimates of individual characteristic variables, persons who answered “a positive function is more important” show higher willingness to pay. Income, livestock breeding experience, farm visiting experience, and the importance of the livestock industry also show more willingness to pay. However, age, education, family size, rural residence, origin from rural areas, agricultural experience, and family of agricultural workers are not statistically significant.

TABLE 5. Estimation Results with Characteristic Variables

Variables	Single Model		Double Model	
	Coefficients	t-value	Coefficients	t-value
Constant	-2.4420	-5.00***	-71,862.05	-4.75***
Presented amount	-0.00002	-8.46***	-	-
Positive function	0.2489	2.39**	10,448.53	3.26***
Age	0.0331	0.80	-251.44	-0.20
Education	0.0960	1.18	-362.72	-0.14
Income	0.0459	1.90*	2,317.46	3.09***
Family size	0.0696	1.49	1,448.33	1.00
Rural residence	-0.0734	-0.59	-1,368.09	-0.35
Origin from rural areas	0.1497	1.27	3,010.16	0.83
Agricultural experience	0.0571	0.48	2,146.00	0.59
Livestock breeding experience	0.2594	2.14**	6,396.82	1.71*
A family of agricultural workers	0.0853	0.78	2,209.17	0.65
Farm visiting experience	0.2372	2.40**	10,533.46	3.44***
Importance of livestock	0.2743	3.01***	9,690.47	3.42***
Importance of livestock in future	0.0557	0.68	1,833.67	0.72
Economic performance	-0.0342	-0.50	477.30	0.22
Economic performance in future	0.0227	0.38	897.63	0.49
Purchasing number/month	-0.0074	-0.13	-429.84	-0.23
σ	-	-	35,133.75	239.00***
Respondents number	881		881	
lnL	-519.081		-1,237.763	
Mean WTP	7,495		9,368	

Note: ***, **, and * are statistically significant at 1%, 5%, and 10% respectively.

The economic value of livestock production externalities, the total willingness to pay for the "Livestock Support Project" in Korea can be calculated by multiplying the number of households. If the estimated amount of willingness to pay per household is multiplied by the total households in 2012, 17,951

thousand, then the total economic values are 151.2 billion won, 185.1 billion won, 134.5 billion won, and 168.2 billion won according to the models respectively. As a result, the total economic value of Korea's livestock externality that reduces the negative non-market functions and increases positive non-market functions to reach the level of advanced countries is about 672.7-925.7 billion won over the next five years.

TABLE 6. Economic Value of Livestock Externality (2012 based)

Model	with Characteristics		without Characteristics	
	Single	Double	Single	Double
WTP per household (won)	8,425	10,314	7,495	9,368
1 year (billion won)	151.2	185.1	134.5	168.2
5 years (billion won)	756.2	925.7	672.7	840.8

VIII. Comparing the Results with Other Studies

Many previous public valuation researches related to multifunctionality of agriculture and rural areas have been done with various methods. The economic values of agricultural multifunctionality were up to at least 1,324 billion to 166 trillion won. If the extreme values are removed, the economic value of agricultural multifuncitonality is 8-26 trillion won. On the other hand, a research (Yang, B.W. et al., 2011) in the livestock industry calculated the animal waste disposal costs as approximately 614 billion won per year and the loss of fertilizer value as 375 billion won with the alternative cost methods.

It is very difficult to directly compare the results of this study to the previous studies' results. Nonetheless, 134.5-185.1 billion won as the economic value of the livestock industry's externality from this study can be assessed as reasonable for the following reasons: First, if we consider the size of livestock production in agricultural production, the value is rational. Second, the value of this study includes not only positive but also negative externalities. Finally, the economic value is conservatively estimated to avoid overestimation.

Table 7. Agricultural and Rural Public Values of Previous Studies

Author	Year	Subject	Method	Value (Won)
Urm et al.	1993	Rice paddy	ACM	269,81 bil.
Oh et al.	2001	Agriculture	CVM, ACM	1,067 bil.
Seo D.K.	2001	Rice paddy	ACM, CVM	13,423 bil.
Seo et al.	2003	Agriculture	ACM, CVM	19,890 bil.
Seo et al.	2003	Food security of rice	ACM	1,666 bil.
Ahn et al.	2003	Rural Area	CVM	8,339 bil
Leem et al.	2004	Rural Area	CVM	1,324 bil
Kang et al.	2008	Agriculture	ACM	67,663 bil.
Whang et al.	2009	Rural Area	CVM, Utility Differential model	2,691-5,134 bil.
Yang S.Y. et al.	2011	Agriculture and Rural Area	-	166,000 bil.
Kim et al.	2012	Agriculture and Rural Area	CVM	6,347-9,327 bil.

Note: ACM is an alternative cost method.
Source: Kim, Y.L. et al. *The Evaluation of the Economic and Public Values of Agriculture and Rural Area in Korea.* Korea Rural Economic Institute. 2012.

IX. Conclusion

The results of the survey and estimation for solving livestock externalities are summarized as follows. First, 65.4% of Koreans consider the positive function of the livestock industry is more important than negative one. People who live in cities, who are younger and male tend to think the positive function is more important.

Second, CVM results show that the willingness to pay for solving livestock externalities, that is to reduce environmental pollution and to increase livestock's amenity, ranges between 7,495 won and 10,314 won per household per year. Some characteristics of person such as positive perception for livestock, high income, having experience of farm visiting and animal breeding tend to increase his/her willingness to pay. The total economic value of livestock externality in Korea is about 134.5-185.1 billion won for five years.

The survey results show that about 65 percent of Koreans consider the livestock industry is important, because it has positive non-market functions

such as food security, reservation of rural landscape, and boosting local economy despite of negative non-market functions such as environmental pollution. Thus, people who work in the livestock industry have to try to expand positive functions and to reduce the negative functions.

The results of measuring the economic value of livestock production externalities provide a justification of current government support to the livestock industry. The amount of willingness to pay from this research means that additional government support to the industry is possible. Therefore, more active policy supports are needed to solve livestock externalities.

In addition, the analysis results show that farm visiting and livestock breeding experiences make people have a positive point of view on livestock, and they have a higher willingness to pay for the "Livestock Support Project." Therefore, the livestock industry has to make people have more chances to visit ranches and experience livestock breeding such as feeding, horse riding, milking. In other words, it is needed to give many educational opportunities to learn about livestock production, importance of livestock, and the justification of support to the livestock industry through expanding tourism using farms or ranches.

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Date Submitted: Aug. 5, 2014
Period of Review: Aug. 5, 2014~Dec. 18, 2014