Research on the Greenhouse Gases Emission Reduction of Pig-breeding Industry in China

Zhongying Hu
School of Economy and Management, West Anhui University, Lu’an, China

Abstract. Pig-breeding process can emit a lot of CH₄, N₂O and CO₂. The contribution rate of pig-breeding in greenhouse gases emission stands first on the list of all livestock breeds in China. The paper gave the way to reduce carbon emission in pig-breeding industry by the respective of environmental techniques. The results showed that we should use the three biogas products and provide households the chances of taking part in clean development mechanism to promote the scientific treatment of pig waste and to reduce emission finally.

1. Introduction
International Committee on Climate Change (2007) pointed that the emissions of methane and nitrous oxide coming from agriculture respectively take up 50% and 60% of the total global emissions [1]. The emission reduction requires a control over agricultural greenhouse gases. The focus of agricultural emission reduction should be put on animal husbandry for planting and forestry industry serves as carbon sink. The output of swine in China ranks first in the world, therefore it’s of vital significance to study the emission reduction of swine industry for cutting agricultural emissions.

Influenced by the residents’ consuming habits, it seems hard to reduce the total carbon emission by cutting down the production of swine in our country. Emission reduction is supposed to be achieved by the reduction in unit carbon emission resulted from improvement in technology. While the key of technological improvement lies on farmers’ adoption on low-carbon technology. Low-carbon technology can be categorized into two types: one is low-carbon production technology. It cuts emissions from the perspective of factor saving and embodied carbon reducing through cutting down factor involvement in unit production consumption. This kind of technology may bring significant savings of factor and cost, thus it is beneficial for individuals and farmers will actively adopt it. The other one is low-carbon environmental technology where the emissions are reduced through the replacement of fuels or fertilizers with biogas products by the proper use of feces treatment. This kind of technology costs much in the treatment process with a positive externality, the farmers are not likely to adopt it usually. Therefore, the concentration of the paper is put on the low-carbon environmental technology of farmers, or namely, factors affecting the process of adopting low-carbon treatment technology.

In accordance with the views of Mi Songhua and Huang Zuhui(2012), Zhou Li and Zheng Xuyuan(2012), the economy, operability and the potential in cutting emissions of feces biogas treatment are obviously better than others[2][3]. Therefore, low-carbon technology is characterized by feces biogas treatment in the paper. The current study proposes that farmers’ adoption in biogas treatment
technology are influenced by various factors. Hu Hao (2008) and others suggested that the main factors affecting farmers’ adoption in biogas technology are cognitive levels of pollution, government pensions, farming scales and so on[4]. Yang Jianzhou (2009) and others pointed that the number of live stock and farming experience both contributes to farmers’ wills to build biogas digester[5]. Yu Yi (2012) and others pointed that farmers’ cognition of pollution, farming scales and government subsidies affect their willingness to treatments remarkably[6]. Zhu Lizhi and Zhao Yu (2012) hold a point that farmers’ awareness of environmental protection and the exterior capital support affect their biogas treatments[7]. Min Jisheng and Zhou Li (2014) maintained that organizational degree is an important factor influencing farmers’ adoption of low-carbon environmental technology[8]. Peng Xinyu and Gao Lei (2014) hold that factors like farmers’ understanding and mastering of biogas technology and actual amount of subsidies received are in significant positively correlation with their adoption of biogas[9].

From the above-mentioned, though there are lots of literatures focus on the factors affecting farmers’ biogas treatment, few are based on the analysis on reducing emissions. Besides, most of them are not representative for low-carbon environmental technology assessment for they are confined to the building wills and decisions without study on the actual application. In fact, the mitigation won’t be achieved if people willing to build the digesters never put it into practice, or people build digester but fail to use their production effectively. In view of this point, this paper tries to use Theory of Planned Behavior to comprehensively take farmers’ building digesters and the use of biogas products into consideration to show the adoption of low-carbon environment technology based on microscopic survey data. It will also give illustrated analysis towards the factors to provide policy suggestions to cut emissions in swine industry.

2.  Analysis Framework and Hypotheses

As a matter of fact, farmers’ adoption of low-carbon environmental technology can be classified as their chosen behaviors. It can be characterized by farmers’ behavior theory. There are three representative theories in the economics for farmers’ behaviors. One is Schults (1964)’ theory in economics of agriculture, which supposes that farmers purse the maximizing profits as the “Economic Man” hypothesis suggested[10]; The second one is Chayanov (1966)’s peasant economics[11] maintaining that the primary goal of farmers’ behavior is to meet the family’s expenditure rather than pursue profits; the third one is Huang Zongzhi (1990)’s historical school[12] holding the view that scale is an important factor influencing famers’ decision.

Afterwards, scholars find it difficult to use sheer economy analysis to explain farmers’ complicated behavior. They begin to take the psychological or social factors into consideration. The Theory of Reasoned Action (TRA) proposed by Fishbein M & Ajzen is quite influential. The theory tries to explain man’s decision behaviors by their attitudes and norms, maintaining that man’s behavior depends on behavior disposition, which can be specified as behavior attitudes and subjective norms[13]. The former one means The attitude towards a certain action from a significant people or group will be smelt by individuals. The latter one means people's behavioral intention to make decisions are encouraged by the support from others and discouragery by the restraint, which increases the difficulty. Then, Ajzen (1991) added the perceptual behavior control variable on the basis of these personal factors controlling the minds, advocating perceptual behavior control ,namely, a person’s feeling of the difficulty about conducting a behavior influence his decision behavior and this has constituted a whole Theory of Planned Behavior (TPB). Its main viewpoint is that farmers’ decision behavior is jointly influenced by behavioral attitude, subjective norm and perceived behavioral control[14]. As for swine farmers, their decisions are highly influenced by the behavioral attitude, the subjective feelings they have on the outside norm, and the outer conditions. Based on the above-mentioned analysis, this paper will propose the following hypotheses to be tested as follows:

Hypothesis 1: Farmers’ adoption in low-carbon technology are influenced by their behavioral attitude. The more correct farmers’ cognition towards low-carbon environment technology adoption attitudes are, the better positive feeling of improving environment they have, and the more they are likely to actively adopt environmental manure disposal technology.
Hypothesis 2: Farmers’ low-carbon environmental technology adoption are influenced by their subjective norm. They will be more willing to adopt the low-carbon environment technology if they are better supported or when more positive subjective norms are put on them; They will be more unwilling to adopt it with more constrain and stress they suffer or when more negative subjective norms are put on them. These subjective norms come from mainly 3 parts: government supervision, the environmental lawsuits from the surrounding residents and the support of relevant organizations or standardized demands. The compulsory requests government puts on the infrastructure building of the feces treatment, the government’s inspection frequency on the farmers’ treatments of feces, biogas products are both added to the environmental supervision pressure put on farmers. Farmers will be faced with the danger of getting fined or shutdown of the farm if they offend the regulations to discharge directly, which will increase the cost of direct discharge and this will urge them to adopt low-carbon and pollution-free treatment. The environmental demand of the surrounding residents is also another important factor to encourage farmers to adopt the method. The closer they are to the residential areas, the more likely they will be faced with the pressure from the surrounding residents, which will lead the farmers to adopt the environmental-friendly feces treatment technology to improve their relationships with neighborhoods. If farmers join the institutions like farming association, professional cooperation agency, they will have access to the relevant information of introduction in environmental technology and the marketing channels of treatments. To guarantee the products’ quality and the organization’s reputation, these organizations may give demanding requests to farmers’ adoption in low-carbon environment technology, the low-carbon technology adoption are therefore improved.

Hypothesis 3: Farmers’ low-carbon environmental technology adoption are influenced by their perceived behavioral control. They will be less likely to adopt the low-carbon environmental technology with more difficulty or restraint the swine farmers perceive for the it. This restraint mainly comes from the capital constrains on technology investment and technological difficulties. Farmers’ investment on technology usually will be put on farming scales and productivity first, which will occupy the investment for environmental management. From the point of pre-building, farmers’ capital binding constraints will be release and they are thus more likely to investing in low-carbon environmental technology if the government can give subsidies to farmers to build the biogas digester, or the farmers can enhance their abilities in financing. From the point of post-building, it will be helpful in improving the efficiency if there are biogas service station around the farms to solve the technological problems on biogas usage timely for farmers. The dealing cost of biogas business will be lower if there are people to come to the door to drag away the biogas residue or lays the pipes, and it will also be easier to sell and utilize biogas products comprehensively, then comes the better reduction effect. It is helpful to find a market for the biogas residue and thus improve the efficiency of comprehensive utilization and emission reduction if there are large planters who might have great demand on the organic fertilizers around the farmers.

3. Positive Analysis

3.1. Data source

The data on swine breeders used in this paper is based on the research conducted by an investigation team. The research involves 341 swine farmers of 10 towns in 4 counties and districts of Anhui Province. Among them 56 are from Shanna Town and Huagang Town, Feixi County (one of China’s Top 100 Economic Strong counties), Hefei; 133 from Shidian Town, Madian Town, Fengjing Township and Wangjielu Township, Huoqiu County (National Poverty County), Luan City; 88 from Liugang Town, Chaan Town, Shouxian County (National Poverty County), Huainan city; 64 from Muchang Town and Shuanghe Town, Jinan District, Luan City (Whose economy is between Feixi County and the latter two). Small and medium scale is chosen by most of the farmers (accounting for 79.18 percent of the total sample), whose annual swine comes-out number is between 50-99 and 100 to 2999. The rest are sporadic farmers with an annual swine comes-out number under 50 and large-scale farmers with an annual swine comes-out number over 3000.
3.2. Model and variables selection

3.2.1. Dependent variables selection and Model determination. The wide-used assessment of the low-carbon technology adoption at present is based on the building of biogas digester, which has its obvious defect. To achieve embodied carbon reduction by the replacing coal gas with biogas or replacing fertilizer with biogas residue is the basic principle of biogas treatment for mitigation. Embodied carbon reduction won’t be achieved for the farmers who build the biogas digester yet not comprehensively utilize it. Therefore, this paper is aimed to characterize the low-carbon technology adoption of the farmers by their comprehensive utilization rate of the biogas residue. The low-carbon technology adoption for the farmers without a biogas digester is valued as 0. The methods used by other farmers who build the digester to treat the biogas residue will be studied, which could be basically divided into 4 different types-home use, provided to the neighbor, marketization, and direct discharging. The proportion of them will be studied. Among these treatments, the last one is considered as a wasting while the other are proper treatment. Biogas treatment efficiency of farmers are then obtained according to their weighted emission reduction contribution rate (biogas for 91.08% and biogas residue for 8.92%) to characterize their low-carbon technology adoption (Y), based on the algorithms and test data of researchers such as Zhu lizhi and Zhao yu. Therefore, value of the low-carbon technology adoption for farmers without a biogas digester or those who equipped with the biogas digester yet totally waste it is 0; The range of the rest is from 0 to 1.

According to the research, the low-carbon technology adoption of interviewed farmers is bit low for the mean value of the whole sample merely reach 0.25. 49.85% of the farmers are equipped with biogas digester. The comprehensive utilization mean value of the biogas products is 48.35%, which is relatively low. Besides, most of the biogas are used as fuel for farmers themselves and neighborhoods. The mean value of the utilization of the biogas residue is 66.09%, which is better than the one of biogas. But most of them are home-used, the marketization treatment occupies only a few of the whole.

Instead of taking the ordinary least square method, which will result in the estimation bias for values of some independent variables (level of low-carbon technology adoption) is 0, the values of the rest variables are taken between 0 to 1, Tobit Model is taken to avoid this problem. The basic form of it used in the paper is as follows:

$$Y_i^* = \beta X_i + \varepsilon_i$$

IF $$Y_i^* \leq 0$$, THEN $$Y_i = 0$$; IF $$Y_i^* > 0$$, THEN $$Y_i = Y_i^*$$

Where $$Y_i$$ is taken as the explained variables, $$Y_i^*$$ is taken as the Observed value of the explained variables. If $$Y_i^* \leq 0$$, then $$Y_i = 0$$; If $$Y_i^* > 0$$, then $$Y_i$$ take values of $$Y_i^*$$. $$X_i$$ is taken as the independent variable, $$\beta$$ is the Coefficient of the independent variable.

3.2.2. Selection of the independent variables. Two classes of independent variables are selected based on the analysis framework of theory of planed behavior mentioned above. Class 1 includes 3 groups of explaining variables-Behavioral Attitude, Subjective Norm and Perceived Behavioral Control($$X_{11}$$-$$X_{13}$$), Class 2 includes Individual Characteristics, Production Characteristics, Regional Dummy Variables ($$X_{11}$$-$$X_{21}$$). The quadratic term of the farm scale is added to the model to better observe whether there is a proper farm scale to improve the low-carbon treatment efficiency.

3.3. Model estimation result and analysis. Tobit model is used in the paper by Eviews8.0 for estimation. The result is as Table 1. Variables consisting with expectation and pass the significance test: Subjective Norm [Sign up the local swine-breeding cooperative($$X_6$$)], Perceived Behavioral Control [Subsidy($$X_7$$), Sales difficulty($$X_10$$)]; Production Characteristics [Non-farm incomes proportion ($$X_{12}$$), Farm scale($$X_{13}$$) and its quadratic term($$X_{13}^2$$)]; Individual Characteristics [Age($$X_{15}$$), Education level($$X_{16}$$)]; Regional Dummy variables [Feixi County($$D_1$$), Shouxian County($$D_2$$)].
Table 1. Tobit Model estimation result

| variables                                           | Coefficient | z test | P-values |
|-----------------------------------------------------|-------------|--------|----------|
| **1. Behavioral Attitudes variables**               |             |        |          |
| Knowing about the low-carbon agriculture($X_1$)     | 0.0624      | 0.9958 | 0.3649   |
| Cognitive degree of feces pollution($X_2$)          | 0.0271      | 0.9061 | 0.3193   |
| **2. Subjective Norm variables**                    |             |        |          |
| Compulsory requirement in building the biogas digester($X_3$) | 0.0930      | 1.2535 | 0.2100   |
| Governmental inspection frequency($X_4$)            | 0.0108      | 0.5426 | 0.5874   |
| Distance to the nearest village ($X_5$)              | 0.0516***   | 2.6517 | 0.0080   |
| Signing up the local swine-breeding cooperative($X_6$) | 0.2102***   | 3.5320 | 0.0004   |
| **3. Perceived Behavioral Control variables**        |             |        |          |
| Subsidy($X_7$)                                      | 0.5387***   | 7.6743 | 0.0000   |
| Loan difficulty($X_8$)                              | 0.0779      | 1.1592 | 0.2464   |
| Surrounding biogas station($X_9$)                   | -0.1018*    | -1.7430| 0.0813   |
| Sales difficulty($X_{10}$)                          | 0.3107***   | 4.5827 | 0.0000   |
| Surrounding large-scale farmer($X_{11}$)            | -0.0635     | -0.9956| 0.3195   |
| **4. Production Characteristics**                    |             |        |          |
| Non-farm incomes proportion ($X_{12}$)               | -0.3568***  | -2.6274| 0.0086   |
| Farm scale($X_{13}$)                                | 0.2557*     | 1.9234 | 0.0544   |
| Quadratic term of farm scale ($X_{13}^2$)           | -0.1220***  | -2.8679| 0.0041   |
| Planting area($X_{14}$)                             | 0.0002      | 0.1254 | 0.9002   |
| **5. Individual Characteristics**                   |             |        |          |
| Age($X_{15}$)                                       | 0.0850**    | 2.1550 | 0.0312   |
| Education level($X_{16}$)                           | 0.0647*     | 1.7419 | 0.0815   |
| Risk attitude($X_{17}$)                             | 0.0477      | 1.1382 | 0.2551   |
| Village cadre($X_{18}$)                             | 0.0817      | 0.6747 | 0.4999   |
| **6. Regional Dummy variables**                     |             |        |          |
| Feixi County($D_1$)                                 | 0.1889**    | 2.1184 | 0.0341   |
| Shouxian County($D_2$)                              | 0.3848***   | 5.2440 | 0.0000   |
| Jinan District($D_3$)                               | -0.0886     | -0.8891| 0.3740   |

Annotations: *, **, *** represents the significance level of 10%, 5%, 1%.

3.3.1. Behavioral Attitudes variables. Knowing about the low-carbon agriculture($X_1$) and Cognitive degree of feces pollution($X_2$) both fail to pass the test. One possible explanation is that farmers’ cognitive level are insufficient to inspire them to take the environmental technology, even they accept the fact of feces pollution. Instead of the environmental technology with positive externality, their first choice is the productive technology which can bring direct profits when it comes to the investment on technology.

3.3.2. Subjective Norm variables. There is a positive correlation between Signing up the local swine-breeding cooperative($X_6$) and their low-carbon technology adoption. It shows that the farmers who sign up the association or other local swine-breeding cooperatives will be restricted by their regulations, thus they are encouraged to build the biogas digester. Furthermore, network of the farmers signing up the cooperative are boarder and they have more chance to receive information of advanced environmental technology, they will have more marketing channel as well. These supports will be helpful to improve their low-carbon technology.

The reason why “Compulsory requirement in building the biogas digester($X_3$)” fail to pass the test is probably for that the final result of emission reduction is actually decided on the comprehensive utilization rate of the biogas treatment while the building of biogas digester is just a precondition for low-carbon technology adoption. The building of biogas digester under the political pressure doesn’t guarantee the utilization of the biogas products. Therefore, it shall not be used to represent the
improvement on the low-carbon adaption. Failure of “Governmental inspection frequency (X4)” in the test is probably because of the insufficiency in inspection dynamics and scope. According to the research, average of annual governmental inspection for the farmer is only 1.32 which concerns more on the feces- treatment equipment while the discharge of the biogas products is nearly dismissed, which result in the wasting of it, decreasing the emission reduction effects. What’s more, most of the farmers are free from the normative pressure from residents for their breeding farms are located far than 0.5km from the nearest village as requested. Due to their small scale of breeding, the sporadic farmers usually located within the village without any environmental equipment, which result in the unexpected result in Distance to the nearest village (X5).

3.3.3. Perceived Behavioral Control. There is a significant positive correlation between Subsidy (X7) and Sales difficulty (X10), which indicates the loan and subsidy from government will release farmers from financial pressure, making a positive influence on their decision. The marketization of biogas products will be further to improve low-carbon technology adoption when the farmers could enjoy a home service (eg. Dragging away their biogas residue or setting up the pipelines) to reduce the marketing difficulty, which means a better marketing condition for the biogas products.

They are tended to invest on the productivity rather than environmental technology with their high financial ability could be the explanation why “Loan difficulty (X8)” fails. Surrounding biogas station (X9) Surrounding large-scale farmer (X11) both fail to pass the test for functions of biogas station are not showing because the staff seldom offer home service for technical guidance or maintenance. Meanwhile the large-scale farmers would rather choose more stable fertilizer than take risk to use organic one like biogas residue.

3.3.4. Production characteristics. There is a negative correlation between “Non-farm incomes proportion (X12)” and low-carbon technology adoption, which indicates that higher non-farm incomes occupation requests higher cost on low-carbon feces treatment that will have a negative effect on the low-carbon technology adoption. “Farm scale (X13)” is positive while its quadratic term (X13^2) is negative. Low-carbon environmental technology adoption of farmers present an inverse-U shape, which shows that with the larger breeding scale comes higher possibility to receive subsidy, then comes better chance to be supervised by the government, afterwards they will be more capable of building the biogas digester. The famers whose farming scale are relatively small produce relatively less biogas products to be used in house or shared with neighborhoods. Wasting will happen if the marketization is not completed When their farming scale reach a certain point and the biogas products are over-produced, influences the environmental technology adaption negatively.

Due to the limited knowledge, farmers usually hold a wrong point that it’s scientific to throw feces to the soil directly, especially for the farmers who have larger scale of planting. They are intended to not build the feces treatment equipment like biogas digester, but to throw it straightly. Therefore the reduction effects is not showed and Planting area (X14) fails to pass the test.

3.3.5. Individual Characteristics. There is a positive correlation of Age (X15) and Education level (X16) with low-carbon technology adoption, which shows that older farmers are more frugal and not willing to waste the biogas products; The higher educated they are, the better awareness they will have on environment protection. Also, it is easier for them to make use of the low-carbon environmental technology to improve the low-carbon environmental technology adoption.

The reason why Risk attitude (X17) fails to pass the test is probably because that even risk fanciers will not risk investing on the environmental technology for its insignificant profits. Meanwhile, Village cadre (X18) fails to pass the test for the farmers, and even the cadres will directly discharge the biogas for it’s hard to be supervised due to the concealment of biogas emission.
3.3.6. Regional Dummy variables. The low-carbon technology adoption of Feixi county and Shouxian county are much higher than the one of control region- Huoqiu county. Feixi county is better in economy and has more strict regulations relatively for all local farmers are requested to build the biogas digester by the government. At the same time the great financial power promises local government to be more capable of subsidizing. Therefore, Feixi county is better in the building of biogas digester and environmental technology adoption. The reason why Shouxian county is better than Huoqiu county is that the local can enjoy a GSP subsidy for biogas digester building, which covers 75% of the cost. According to the research, only one farm can enjoy a twenty-thousand subsidy for transformation of the feces treatment equipment per year. It is hard for the small and medium scale and sporadic farmers to receive government’s support. Therefore, they will firstly build the household biogas digester and take the household subsidy to make up for the building cost before transforming it on the farm standard, which improve their possibility of building objectively. At the same time, the reduction effects are improved because the reformed biogas digester produce less biogas products thus they will get better chance to be used comprehensively.

4. Conclusion

Based on measure data, the paper implies Theory of Planned Behavior to establish analytical framework and constructs Tobit model to make empirical research on the factors effecting farmers' adoption in low-carbon environmental technology. The result points out: (1) Farmers’ adoption in low-carbon environmental technology is directly related to their subjective norms. If farmers join farming cooperatives, their adoption in low-carbon technology will be better. (2) It is also directly related to perceived behavior control. If farmers can get subsidies for building digesters and there are corporations or individuals purchasing their biogas products, their adoption in low-carbon technology will be better. (3) It is related to Production Characteristics like non-agricultural income and farming scales. The adoption in low-carbon environment technology negatively relates to the proportion of non-farm incomes and it has an inverse-U shape relation with farming scales, which increases at first while decreases latter. (4) It is related to Individual Characteristics. The elder the decision-makers are, the more education they receive, the higher adoption in low-carbon environment technology they have. (5) It is related to regions. The adoption in low-carbon environmental technology are significantly better in county areas where economy grows faster and subsidies are higher. According to these conclusions, the following political recommendations are proposed:

First, regulations to make farmers under the constraint of government and trade associations. The government should have a whole-process and frequent supervision on farmers. Environmental tests shouldn't be limited on the digester building or feces discharging. It should be extended to the standard emission of biogas products. At the same time, the swine farmers should be encouraged to join various assisting associations such as farming trade association, cooperatives to make them constrained by relevant associations' standardized norms.

Second, subsidize precisely to change the cost-benefit of adopting low-carbon environmental technology. Considering the externality of environmental technology, the government should give subsidies to those who adopt low-carbon environmental technology. It is suggested that the government can have a reference to the practice of subsidizing household building of biogas digesters and gradually complete the GSP subsidy. Furthermore, the subsidy for later maintenance and use of fecal biogas treatment should be increased to improve efficiency.

Third, service well to improve the marketing of biogas products. The government ought to provide preferential policy to guide the biogas products demander such as Power plant, organic fertilizer manufactures and grain production households to cooperate with farmers to create conditions for them to purchase, lay pipes on the door and so on to solve the problems that occur in the marketing of biogas products and improve the comprehensive utilizing efficiency of low-carbon environmental technology treatment so as to reduce emission in a real sense.

Fourth, formalization moderately to bring the effect of emission reduction into play. The expected profits are low and it's hard to reduce the fixed cost of environmental treatment and the farmers will tend
to discharge the feces directly when the farming scale is too small. It can easily cause wastes for the biogas products on the condition that the market of fecal treatment is not developed when the farming scale is too large. Therefore, the government is supposed to encourage medium-scale farming on the perspective of the ultimate emission reduction efficiency of environmental technology.

Acknowledgments
This paper is supported by The project of building the first-class subject for Agricultural Economy and Management in Anhui province and The study starting funds for high-level talents of West Anhui University (WGKQ201702014).

References
[1] Intergovernmental Panel on Climate Change. IPCC WGI Fourth Assessment Report[R]. Switzerland:IPCC,2007:104.
[2] MI Song-hua, HUANG Zu-hui. Applicability Screening of Mitigation Technologies and Management Practices of Emissions of Greenhouse[J]. Scientia Agricultura Sinica, 2012, 45(21):4517-4527.
[3] ZHOU Li, ZHENG Xu-yuan. Green Subsidy Policy Effect Assessment Based on Farmers Willingness to Pay for the Low-carbon Elements: An Empirical Study in Swine Industry[J]. Journal of Nanjing Agricultural University (Social Sciences Edition), 2012, 12(4):85-91.
[4] HU Hao, ZHANG Hui, YUE Dan-pin. An Analysis of the Determinants in Option of Biogas Technology for Swine Farmers in Jiangsu Province[J]. China Biogas, 2008, 26(5):21-25.
[5] ZHOU Li, ZHENG Xu-yuan. Green Subsidy Policy Effect Assessment Based on Farmers Willingness to Pay for the Low-carbon Elements: An Empirical Study in Swine Industry[J]. Journal of Nanjing Agricultural University (Social Sciences Edition), 2012, 12(4):85-91.
[6] YU Yi, ZHANG Hui, HU Hao. Study on the Factors Affecting Breeding Farmers' Environmental Investment in the Perspective of Pollution Subsidies: Based on the Survey of Farmers from Shanghai, Jiangsu and Zhejiang[J]. China Population, Resources and Environment, 2012, 22(2):159-163.
[7] MIN Jisheng. Do Systematization Reduced Carbon Emissions of Scale Hog Raising Households? Evidence from the 229 Scale Hog Raising Households of Three Cities in Jiangsu Province[J]. Issues in Agricultural Economy, 2014, (9):35-39.
[8] PENG Xin-yu, GAO Lei. Empirical Study on the Factors Affecting the Biogas Technology Adoption Decision in Rural Poverty-stricken Area[J]. Systems Engineering, 2014, 32(8):137-142.
[9] Theodore W. Schultz. Transforming Traditional Agriculture[M], New Haven: Yale University Press, 1964.
[10] AV Chayanov. The theory of peasant economy[M], Madison: University of Wisconsin Press, 1966.
[11] Philip C. C. Huang. The Peasant Family and Rural Development in the Yangzi Delta, 1350-1988[M], Redwood City: Stanford University Press,1990.
[12] Fishbein M. and Ajzen, I. Belief, Attitude, and Behavior: An Introduction to Theory and Research [M] MA:Addision-Wesley,1975.
[13] Ajzen, I. The Theory of Planned Behavior[J]. Organizational Behavior and Human Decision Processes, 1991, (50):179-211.