Why Is the "Polluter Pays Principle" Difficult to Implement in Rural Areas? A Study on Pig Farmers' Payment Behavior in Third-Party Governance of Pig Farming Pollution in Nanping (Postprint)

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Abstract

In third-party governance of livestock breeding pollution, timely payment of pollution treatment fees by polluters is both a requirement of the "Polluter Pays Principle" and key to the sustainable operation of third-party governance. However, in practice, there exists a phenomenon of pig farmers not paying pollution treatment fees in a timely manner. To investigate the reasons, this study surveyed the third-party governance fee payment behaviors of 117 pig farmers in 7 villages in Luxia Town, Nanping City, Fujian Province, applied a logistic regression model to analyze key factors influencing payment behavior, and explored why the "Polluter Pays Principle" is difficult to implement in rural areas. The results show: (1) The "Polluter Pays Principle" is difficult to implement in third-party governance of rural livestock breeding pollution, with a low proportion of pig farmers paying fees, which seriously affects the normal operation of third-party governance. Although 73.50% of pig farmers believe they should pay fees, only 61.54% have actually paid the governance fees. The main reasons are: farmers use their own requirements for living environment as the basis for judgment, ignoring the environmental negative externalities generated by local breeding activities; pig farmers have not truly understood the connotation and requirements of the "Polluter Pays Principle" ; the psychology of conformity, comparison, and "the law cannot punish the masses" in rural acquaintance societies; the gap between pig farmers' perception of third-party governance effectiveness and their expectations; and the lack of means and mechanisms for grassroots governments to implement the "Polluter Pays Principle." (2) Production and operation characteristics, family characteristics, and personal characteristics have significant effects on pig farmers' payment behavior, with the degree of influence in descending order as: business type >

average education level > household head age > proportion of external breeding capital > farm area > net breeding income. (3) Due to minimal differences in individual external factors, they have no significant effect on pig farmers' payment behavior. Therefore, it is necessary to enhance pig farmers' environmental awareness and sense of responsibility, promote scaled and corporate operation of the breeding industry, strengthen the cultivation of new professional farmers, establish and strictly implement grassroots enforcement mechanisms for "Polluter Pays," thereby promoting third-party governance of breeding pollution and the sustainable development of the breeding industry.

Full Text

Why the Polluter-Pays Principle Is Difficult to Implement in Rural Areas: A Case Study of Pig Farmers' Payment Behavior Under Third-Party Governance of Pig-Farming Pollution in Nanping

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Abstract

In recent years, the livestock breeding industry has significantly contributed to rural economic development as a pillar industry, yet it has also caused severe environmental pollution in rural areas for an extended period. Dust, harmful gases, and sewage from livestock breeding have not only affected the survival rate of livestock and poultry but also endangered the health of residents in surrounding areas. Professional third-party governance of waste represents a rapidly developing trend in pollution management, where timely payment of pollution fees by polluters is both a requirement of the "polluter-pays principle" and crucial for the continuous operation of third-party governance systems.

However, in practice, many farmers fail to pay pollution fees on time. To identify the underlying reasons, this study investigated the payment behavior of 117 pig farmers across seven villages in Luxia Town, Nanping City, Fujian Province, using logistic regression analysis to examine key influencing factors and explore why the polluter-pays principle faces implementation challenges in rural settings. The results reveal several critical findings: (1) The polluter-pays principle is indeed difficult to implement in rural livestock pollution third-party governance, with low payment rates seriously affecting normal operations. While 73.50% of pig farmers believed they should pay, only 61.54% actually paid the governance fees. The main reasons include farmers judging environmental requirements based on their own living conditions while ignoring the negative externalities of local breeding activities; failure to truly understand the polluter-pays principle; conformity, comparison, and "law cannot punish the masses" mentality in rural

acquaintance societies; large gaps between perceived and expected third-party governance effectiveness; and lack of mechanisms and instruments at the grassroots government level to enforce the polluter-pays principle. (2) Production and management characteristics, family characteristics, and individual characteristics significantly influence payment behavior, with the degree of impact descending as follows: operating type > average education level > household head age > proportion of external capital > farm area > net breeding income. (3) Due to minimal variation in external factors among individuals, their influence on payment behavior was not significant. Therefore, enhancing pig farmers' environmental awareness and sense of responsibility, promoting scaled and corporate management of breeding operations, strengthening the cultivation of new professional farmers, and establishing and strictly implementing grassroots mechanisms for the polluter-pays principle are essential to promote sustainable third-party governance of breeding pollution and the healthy development of the livestock industry.

Keywords: Livestock breeding pollution; Polluter-pays principle; Third-party governance; Payment behavior; Breeding farmers

1. Theoretical Analysis and Research Design

In third-party governance of breeding pollution, the third-party enterprise treats pollutants according to contract requirements, improves water environments, and charges governance fees based on treatment costs. Government subsidies, pollution fees from pig farmers, and revenue from waste recycling constitute the main income sources for third-party governance enterprises. According to the polluter-pays principle, pig farmers, as pollution generators, should bear the majority of governance costs. Therefore, timely payment of pollution treatment fees by pig farmers is critical for the normal operation of third-party governance enterprises.

Extensive international research indicates that gender, age, social class, and external environmental factors are primary determinants of farmers' environmental awareness [**?**]. Domestic studies show that pig farmers' education level, farm scale, and public awareness also affect their environmental consciousness [**?**]. Larger-scale farms tend to implement better environmental practices to increase profits, and both operation duration and management model are closely related to environmental behavior [**?**]. Based on this theoretical foundation and existing research, this study posits that pig farmers' payment behavior for livestock pollution treatment fees depends primarily on individual characteristics, family characteristics, production and management features, and external environmental factors, as illustrated in the analytical framework [Figure 1: see original paper].

To identify significant factors influencing pig farmers' payment behavior for livestock pollution treatment fees, this study employs a binary logistic regression

model:

$$\log\left(\frac{P}{1-P}\right) = \alpha + \sum_{i=1}^{n} \beta_i X_i$$

where P represents the probability of pig farmers paying third-party treatment fees, $1-P$ represents the probability of non-payment, $X_i(i = 1, 2, 3, \ldots, n)$ are factors influencing payment behavior, α is the constant term, and $\beta_i(i = 1, 2, 3, \ldots, n)$ are regression coefficients for each factor. Positive coefficients indicate positive correlations with payment behavior, while negative coefficients indicate negative correlations.

The dependent variable is pig farmers' payment behavior for pollution treatment fees, denoted as Y ($Y = 0$ for non-payment, $Y = 1$ for payment). Independent variables include: household head age (X_1), gender (X_2), health status (X_3), number of family members engaged in breeding (X_4), average education level (X_5), operation type (X_6), distance from farm to river (X_7), proportion of external capital (X_8), operation years (X_9), farm area (X_{10}), net breeding income (X_{11}), pig market risk (X_{12}), third-party governance effectiveness (X_{13}), and government supervision and enforcement strength (X_{14}).

Among these variables, household head characteristics include age, gender, and health status. Generally, younger household heads in good health and male farmers are more likely to pay treatment fees. Family characteristics include the number of family members engaged in breeding and average education level. More family members involved in pig farming may increase livelihood dependence and reduce willingness to pay, while higher education levels deepen understanding of the polluter-pays principle and increase payment likelihood. Production and management characteristics include operation years, operation type, distance to river, farm area, proportion of external capital, and net income. Longer operation years increase reliance on traditional treatment methods and reduce payment willingness. Joint operations are typically closer to breeding communities, larger in scale, and face higher opportunity costs from potential demolition, making them more likely to pay. Larger scales mean higher fees and potentially lower willingness, while higher proportions of external capital may reduce payment likelihood. Greater distance from rivers reduces detection risk and payment willingness. Higher net income increases payment capacity and likelihood. External environmental variables include policy enforcement strength, third-party governance effectiveness, and market risk. Stronger enforcement increases punishment risk for direct discharge; better governance effectiveness makes farmers feel the fees are worthwhile; lower market risk provides stable income and increases payment probability. Variable descriptions and expected effects are summarized in .

2. Study Area and Data Sources

Luxia Town in Nanping City, Fujian Province, is located at 26°15 -26°34 N, 118°14 -118°21 E. The town comprises 10 administrative villages with 3,312 households and 13,072 residents. Since the 1990s, when the government promoted breeding to resettle reservoir migrants, the industry has become the town' s pillar industry for over two decades, with pig production accounting for 70% of local GDP. In 2016, nearly 300,000 pigs were marketed. The town is dominated by small-scale household farms, with few large-scale operations. Pollution control efforts have been ineffective due to land constraints for treatment facilities, capital shortages among farmers, and incomplete government supervision.

Influenced by long-standing direct water-flushing discharge practices and located in the ecologically sensitive upstream area of the Min River, breeding pollution has caused most local rivers to fall below Grade V water quality standards. At the end of 2014, the town government introduced a third-party pollution control enterprise through bidding, signing contracts to delegate polluted water areas to third-party governance for constructing a zero-emission resource-recycling economy and water restoration project. The government provides support through four mechanisms: farmland rent subsidies (4,500 kg · hm ^{2} · a ^{1}, with government and third party each bearing 2,250 kg · hm ^{2} · a ^{1}), construction land subsidies (750,000 yuan for 2 hm^{2} of factory construction land at industrial park standards), tax reductions on environmental service value-added tax, and project reward subsidies. The town established 42 treatment sites across seven villages, covering 11.778 hm^{2} and targeting 1,195 pig-farming households in the upstream Duxi River basin. The governance fee standard is 2 yuan · m ^{2} · month ^{1}, collected by the government every three months. A breeding pollution control office was established to track watershed governance progress, verify farming areas, and assess third-party governance results. However, in practice, only 26% of pig farmers proactively paid pollution treatment fees .

To investigate reasons for non-payment, this study conducted multiple short interview-based surveys, followed by face-to-face interviews in September 2016 with the Nanping Yanping District government, Luxia Town government, Livestock Breeding Pollution Control Office, Environmental Protection Bureau, and the third-party enterprise Zhengda Orixin. In December 2016, field surveys were conducted in seven villages (Luxia, Shecun, Xiajing, Tiantou, Yangwei, Guanzhuang, and Longcun). Random questionnaires were administered to 132 pig farmers, covering basic household information, breeding conditions, income and costs, biogas digester construction and usage, and attitudes toward environmental pollution and third-party governance. A total of 117 valid questionnaires were obtained (88.6% response rate), with descriptive statistics shown in . Most household heads were middle-aged or elderly, with primary or junior high school education, and small-scale operations of 100–500 head inventory. Additionally, 95 households (81.1%) had constructed biogas digesters, but usage was unsatisfactory: 9 were unused, 46 had never been cleaned, and 40 were cleaned only once every two years, rendering them ineffective for ecological improvement.

3. Results and Analysis

3.1 Pig Farmers' Cognition of Pollution Control Responsibility and Payment Behavior

Pig farmers' cognition of their pollution control responsibility is crucial for their behavioral choices. As shown in , 73.50% of surveyed pig farmers believed they bear responsibility for controlling breeding pollution and endorsed third-party governance models, indicating some environmental awareness. However, the actual payment rate was low; after repeated government reminders, door-to-door persuasion, and ideological work, only 61.54% had paid the fees. Considering that many non-payers were unwilling to be interviewed, the actual payment proportion among all liable households may be even lower.

3.2 Analysis of Factors Influencing Payment Behavior

Using SPSS 17.0 statistical software, binary logistic regression analysis was conducted on factors influencing pig farmers' payment behavior, with results presented in .

The results indicate that six factors significantly influenced payment behavior: operation type (X_6), average education level (X_5), household head age (X_1), proportion of external capital (X_8), farm area (X_{10}), and net breeding income (X_{11}), with decreasing influence magnitude.

3.3 Reasons for Refusing Third-Party Governance Fees

Based on field interviews and data in , five main reasons emerged for refusing payment:

First, breeding pollution was not considered the primary local pollution source or a direct threat to farmers' lives, and thus not a priority for control. Most households in Luxia Town drink mountain spring water, while pig sewage primarily affects downstream water bodies and residents using that water. With pig farming common since the 1990s and having enriched most families, farmers have become accustomed to the pollution. Combined with low education levels, they do not view breeding pollution as the most important source, instead considering household waste and factory discharge as primary pollutants.

Second, pig farmers have not truly understood or accepted the polluter-pays principle. First, they generally view governance fees as extra expenses rather than necessary costs, worrying they cannot afford fees when market conditions are poor, creating resistance. In sample villages, pig farming accounts for 80–90% of gross output value and is the main income source. Unstable pig prices make farmers fear that paying fees during market downturns increases losses,

especially after years of low prices when most operated at a loss, fostering resistance to fee payment. Second, farmers cannot correctly recognize their governance responsibilities. While 73.50% agreed they bear responsibility for pollution control, only 8.55% believed they should bear primary responsibility when asked who should pay, with 36.75% believing the government should. This reveals most farmers have not fundamentally grasped the polluter-pays principle. Internalizing previously government-borne costs and environmental losses into polluters' production costs requires more education and stronger incentive-constraint mechanisms.

Third, farmers exhibit herd mentality, 观望 (wait-and-see attitudes), procrastination, comparison, and "law cannot punish the masses" psychology. Among 45 non-paying households, 46.67% were unwilling to pay first, hoping to be the last, and refused payment if they knew others hadn' t paid. Small-scale farmers believed large operations should pay while their own small-scale pollution was negligible. Large operators felt everyone should pay together, leading to mutual shirking and delays. Although many recognized their responsibility, in rural acquaintance societies, people were unwilling to appear as "zealots" or "fools," believing late payment was better than early, and non-payment better than late payment, delaying and evading whenever possible. Without payment incentives or constraints, everyone waited and saw, with few proactive payers, resulting in slow collection and high costs.

Fourth, third-party governance effectiveness was unsatisfactory. Forty-seven percent of respondents rated effectiveness as average or poor. Many reported third-party enterprises engaged in illegal discharge, had poor-quality pipes that frequently ruptured, and located treatment sites too close to villages, worsening air quality. They felt third-party governance had little effect and thus did not merit payment. In reality, governance effectiveness varied significantly across villages, affecting farmers' acceptance of third-party models and creating obvious inter-village differences in payment behavior. Villages with better results had higher payment rates.

Fifth, grassroots governments lack instruments and mechanisms to implement the polluter-pays principle. All 117 interviewed households reported never being penalized for breeding pollution. Grassroots officials stated they could not adopt compulsory measures, and relying solely on propaganda, guidance, and persuasion proved ineffective.

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4. Impacts of Pig Farmers' Third-Party Governance Fee Payment Behavior

Operation type, proportion of external capital, farm area, net breeding income, average family education level, and household head age significantly influenced payment behavior. The absolute values of influence coefficients ranked as: operation type > average education level > household head age > proportion of

external capital > farm area > net breeding income .

Operation characteristics were the most critical factors, with four significant factors accounting for two-thirds of the total. Operation type showed the strongest influence (coefficient = -2.831), indicating its paramount importance. Regarding operation type, joint operations are relatively larger in scale, require higher fees, and necessitate collective decision-making among participating farmers. In individualistic group decisions, members focus only on personal benefits, leading to decisions that avoid fee payment [**?**]. Contrary to initial assumptions, higher proportions of external capital increased payment willingness, primarily because larger external capital ratios correlate with larger scales and higher industry dependence, making farmers fear greater losses from non-payment and thus more likely to "cooperate." Similarly, larger-scale farmers with higher industry dependence are less likely to evade fees, as the risk of demolition or penalties for non-payment is greater. Therefore, despite higher fees, large-scale farmers had higher payment rates, positively influencing payment behavior—opposite to expectations. Net breeding income positively correlated with payment behavior, consistent with expectations.

Family characteristics, particularly average education level, significantly and positively influenced payment behavior (coefficient = 0.456, significant at 1% level). Higher education enhances non-breeding employment capacity, deepens understanding of the polluter-pays principle, and increases acceptance of third-party governance. Notably, the number of family members engaged in breeding did not significantly influence payment behavior, despite a coefficient of -0.35. This suggests that in household decisions about third-party fee payment, average education directly affects understanding of the polluter-pays principle and behavioral choices. Families with lower education and multiple breeders showed lower acceptance, emphasized economic interests, and were more unwilling to pay, representing key targets for policy advocacy.

Individual characteristics, especially household head age, moderately influenced payment behavior (coefficient = 0.072). Gender and health status showed no significant influence, contrary to initial hypotheses. Older household heads have stronger local breeding dependence, lower out-migration likelihood, and stronger pollution perception, making them more willing to pay third-party fees. Elders often serve as clan leaders or senior figures with strong influence in rural society and can play significant exemplary roles in environmental governance [**?**]. Therefore, leveraging the social influence of older farmers is essential.

External environmental factors showed no significant influence due to minimal individual variation. Market risk, third-party governance effectiveness, and government supervision strength did not significantly affect payment behavior, contrary to expectations, primarily because the survey focused on Luxia Town in Yanping District, where external environments were similar across farmers. However, regression coefficients and interviews revealed that when market conditions were favorable (as in 2016), payment rates increased significantly. Additionally, overemphasizing governance effectiveness in propaganda while actual

results fell short of expectations hindered fee collection and reduced trust in government. Therefore, governments should emphasize farmers' governance responsibilities and third-party model efficiency when promoting third-party governance, while establishing performance-based payment mechanisms to enhance understanding of the polluter-pays principle and improve payment rates.

5. Discussion and Conclusions

Introducing third-party governance represents a major future trend in breeding pollution control. This study focuses on pig farmers' governance behavior choices after third-party involvement, exploring key factors influencing payment behavior to enrich theoretical research on rural environmental governance. Logistic regression analysis reveals that household head age, proportion of external capital, average education level of breeders, and farm area positively and significantly influence payment behavior, while net breeding income and operation type have negative significant effects. Average education level of breeders shows particularly strong influence. This case study of Nanping' s Yanping District could not fully analyze external environmental factors, though rural social culture, clan relations, economic levels, and industry types may also significantly influence payment behavior. Future research should expand geographic coverage using village-level samples to reveal external factor impacts. Considering rural social transformation during urbanization, dynamic analysis using time-series data represents an important research direction.

Based on the above analysis, three main conclusions emerge:

First, payment under the polluter-pays principle in rural breeding pollution third-party governance is unsatisfactory, primarily because pig farmers ignore downstream environmental externalities, fail to understand the polluter-pays principle, exhibit herd mentality and "law cannot punish the masses" psychology in acquaintance societies, perceive large gaps between actual and expected third-party governance effectiveness, and face grassroots governments lacking implementation mechanisms. Therefore, strengthening education to enhance environmental awareness, improve public cognition of breeding pollution hazards, and help farmers understand that paying third-party fees is a wise win-win choice is crucial. Leveraging rural social networks according to acquaintance society characteristics can facilitate polluter-pays principle implementation [**?**]. Increasing farmers' participation in third-party governance decisions, enhancing their cognition, and strengthening grassroots governments' enforcement authority in rural environmental policy are essential.

Second, factors influencing third-party fee payment behavior include operation characteristics, family characteristics, and individual household head characteristics, with six significant factors ranked as: operation type > average education level > household head age > proportion of external capital > farm area > net breeding income. Therefore, targeted policies based on these characteristics

can improve polluter-pays principle implementation. Specifically: (1) promote scaled, intensive, and corporate breeding operations to enhance farmers' pollution control capacity and responsibility awareness while clarifying responsible entities; (2) strengthen cultivation of new professional farmers to improve environmental awareness and capacity; and (3) fully leverage social capital, such as older farmers' exemplary roles, in third-party governance.

Third, although external factors showed no significant individual influence due to minimal variation, they substantially affect overall behavior. Therefore, stabilizing pig market prices, reducing breeding risks, and improving farmers' capacity to bear governance costs; establishing and strictly implementing reasonable polluter-pays mechanisms; and improving third-party governance performance evaluation and information disclosure systems to create transparent, service-level-based pricing mechanisms will all enhance polluter-pays principle implementation in rural areas.

References

[?] Qiu H G, Jing Y, Liao S P, et al. Environmental pollution of livestock and the effectiveness of different management policies in China. *China Environmental Science*, 2013, 33(12): 2268–2273.

[?] Huang G Q. Problems and countermeasures of sustainable development of agricultural ecosystem in Southern China. *Chinese Journal of Eco-Agriculture*, 2016, 25(1): 13–18.

[?] Feng X J, Wei C F, Xie D T, et al. Effects of farm household' s management behavior upon nonpoint pollution of agriculture and model analysis. *Chinese Agricultural Science Bulletin*, 2005, 21(12): 354–358.

[?] Hou J D, Lü J, Yin W F. Effects of farmer households' production and operation behaviors on rural eco-environment. *China Population, Resources and Environment*, 2012, 22(3): 26–31.

[?] Wang H A, Ye H, Wang Y P. Study on the agricultural non-point source pollution and farm household' s management behavior: An empirical study and analysis of farmer households in Hubei Province. *Ecological Economy*, 2009, (9): 87–91.

[?] Bin M R, Zhou F M. Farmers' willingness to investment in livestock breeding pollution treatment: Based on 388 livestock farming households in Hunan Province. *Journal of Hunan Agricultural University: Social Sciences*, 2015, (3): 87–92.

[?] Yu Y, Zhang H, Hu H. 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. *China Population, Resources and Environment*, 2012, 22(2): 159–163.

[?] Mo H X, Qiu H G, Wang J X, et al. Treatment mode and its influencing factors of livestock and poultry waste in China. *Agro-Environment and Development*, 2011, 28(6): 59-64.

[?] Pan D. Policy choice of livestock manure pollution control based on farmers' preference. *China Rural Survey*, 2016, (2): 68-83.

[?] Xiao P, Zhu G H. Research on the third party governance contract of rural environmental pollution. *Rural Economy*, 2016, (4): 104-108.

[?] Gorman M, Mannion J, Kinsella J, et al. Connecting environmental management and farm household livelihoods: The rural environment protection scheme in Ireland. *Journal of Environmental Policy and Planning*, 2001, 3(2): 137-147.

[?] Mccann E, Sullivan S, Erickson D, et al. Environmental awareness, economic orientation, and farming practices: A comparison of organic and conventional farmers. *Environmental Management*, 1997, 21(5): 747-758.

[?] Zhou J B, Zou J. The evaluation and influence factor of Beijing' s public environmental awareness. *Social Sciences of Beijing*, 2005, (2): 129-133.

[?] Tang S Y, Qi Z H, Liang F L. Empirical research on influencing factors of the ecological awareness of the scale pig farmers. *Science and Technology Management Research*, 2014, (15): 229-233.

[?] Sun S M, Lu F J, Ye J. Study on the mechanism of behavior selection and the optimization strategies of pig farm in high quality pork supply chain. *Operations Research and Management Science*, 2004, 13(5): 105-110.

[?] Wu L Y, Qi Z H, Li X R, et al. An empirical research of influencing factors of pig farming enterprise' s environmental behavior. *Journal of China Agricultural University*, 2015, 20(6): 290-296.

[?] Zhang R, Ren H. The influence model of group decision making. *Statistics & Decision*, 2006, (6): 52-55.

[?] Du Y Q, Sun X X, Xu J X, et al. Analysis of livestock farming pollution control in ecologically sensitive areas through socio-ecological lens: A case of the water sourcing buffer zone of Xiqin Water Plant in Nanping City, Fujian Province. *Chinese Journal of Eco-Agriculture*, 2014, 22(7): 866-874.

[?] Du Y Q, Liu P Y, Bao C K, et al. A study on the rural environmental governance through the lens of social capital—A case of livestock farming pollution in the undeveloped region. *Journal of Public Management*, 2016, (4): 101-112.

Note: Figure translations are in progress. See original paper for figures.