Research on the Impact of Policy Transmission on Pollution Control of Livestock Breeding

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Abstract. Scientific policy transmission is the key for local governments to effectively control pollution from livestock breeding. This study collects the livestock manure treatment policy texts and livestock feeding data of 70 local governments, and uses data mining and related analysis methods to analyze the relationships between actions, actors and the effect of livestock breeding pollution control in local government policies. The results show that: the better the transmission of actions and the greater the number of actors involved in transmission of actions, the better effect of livestock breeding pollution control. It is necessary to strengthen collaboration with Department of Natural Resources in building a cycle of planting and breeding development mechanism as well as acceleration of the transformation and upgrading of animal husbandry. Meanwhile, the collaboration with Department of Science and Technology should be enhanced in strengthening fiscal and taxation policy support, and coordinating the solution of land and electricity use problems.

1. Introduction
According to Communiqué on the Second National Pollution Source Survey in 2020, the amount of livestock manure produced in China in 2017 was 3.818 billion tons, and the discharge of chemical oxygen demand was 6.0483 million tons, accounting for 60.4% of the total discharge of water pollutants. Pollution from livestock breeding is the largest source of pollution in China's water environment. Since environmental pollution has negative external benefits and causes market mechanisms to fail, the governance of livestock breeding pollution requires government actions. Public policy is an action plan taken by the government to solve public problems, achieve public goals, and promote public interests. In June 2017, the General Office of the State Council issued the Opinions on Accelerating the Utilization of Waste from Livestock Farming (hereinafter referred to as the Opinions) to construct an action plan for livestock breeding pollution control. Chinese government system is a bureaucratic organization based on Max Weber's hierarchical bureaucracy theory, which is divided into central government, provincial government, municipal government, subdistrict office, and residential committee. As a result, public policies need to be passed and shared by governments at all levels. However, the public policy will inevitably be distorted in the process of multi-level government transmission, resulting in public policy not being able to perform its expected functions. From the perspective of structure and function, this research explores the relationship between policy transmission and the effect of livestock breeding...
pollution control, which is of great significance to the construction of local government's livestock breeding pollution control system.

The research on policy transmission originated from the study on the signal transmission effect of capital market dividends[1]. The signal transmission theory believes that under the premise of information asymmetry, action is a stronger signal than language, and the trustee will use the action of the sender as a signal to change their actions. Inspired by researches on dividend signals, some scholars have conducted the research on the transmission effect of monetary policy, which is also an important signal of the capital market[2], and initiated the research on policy transmission based on information theory. Policy text is the information carrier of policy, so Chinese scholars use policy text as an important path to study policy transmission. Wei J established a policy transmission model of policy source-transformation-channel-policy sink, using different policy types as transformations and bureaucracy as the channel, and pointed out that policy interception, policy misinterpretation, policy addition and policy lag are the noise of the channel, which affected the quality of policy delivery[3]. Xue L and Tang LY believed that the deviation between the utility function of the central government and the utility function of the local government is the main reason for bureaucratic loss in the process of policy transmission, thus a game model was constructed to explain[4]. Based on the content analysis method, Yu GX and Zeng GJ conducted a text quantitative analysis on the policy transmission of characteristic towns, and built a policy action system[5]. In general, the existing researches on policy transmission based on information theory are relatively comprehensive as well as gradually moving towards quantification.

The existing researches on policy transmission have the following shortcomings: First, there are deficiencies at the theoretical level. Information theory can explain the reason for the distortion of information transmitted by policies, but it cannot explain how the distortion of information causes the loss of public interests. The structural function theory believes that the social structure is based on the action system, which is a series of independent social actions with coupling relationships[6]. Distortion of policy transmission means the lack of social actions, which brings about the social structure change, and causes an influence on the performance of functions and realization of public interests. Structural function theory can explain the influence of distortion of policy transmission more deeply than information theory. Second, there is a lack of empirical research on the practical level. Existing researches believe that information distortion will cause the loss of public interests, and all of them can be realized as long as the lossless transmission of policies is guaranteed. However, the objective conditions of local governments vary greatly, and they cannot all copy policies of the central government. Moreover, there are many actions in policies of the central government, therefore delivering what actions are beneficial to the governance of local governments requires empirical analysis of actions and governance effects. Third, the role of actors in the transmission of actions is ignored. Zadek S pointed out that the departmental collaboration is a necessary means to solve complex ecological and environmental problems[7], when Hoel M found that the departmental collaboration can improve the efficiency of policy implementation[8]. Existing researches on policy transmission mainly focus on the transmission of actions, ignoring the huge influence of the collaboration of actors on governance effect, at the same time, attention on policy transmission is not comprehensive. In view of this, the research uses R language to excavate the Opinions of 70 local governments, and analyzes relationship between actions, actors and governance effect in the Opinions, in order to provide a reference for improving the effect of local government livestock breeding pollution control.

2. Data cleaning and research methods

2.1. Data source and cleaning

2.1.1. Data Source. This study collects the Opinions successively formulated by local governments since 2017 as the text data source. Since the strict implementation of the policies in 2017 has triggered huge changes in the number of livestock breeding in various regions, it is not conducive to investigating
the long-term effects of the policies. Therefore, this study selects the data of pig, cattle, and sheep breeding in 2018 and 2019 from the local statistical yearbook, calculates the amount of livestock manure produced on this basis, and uses the rate of change in the amount of livestock manure produced during the two years as the effect of livestock breeding pollution control, for reasons of data availability, a total of 70 local government data were collected.

2.1.2. Data cleaning. The procedures for data cleaning are as follows: (1) Clean up actions. The actions of local governments shall be expressed in a unified manner. (2) Code actions. For example, the code of strictly implementing the environmental assessment system for large-scale livestock breeding is Action1, and the specific coding results are shown in Table 1. (3) Clean up and code government departments, such as Department of Ecology and Environment is coded as D1, and the codes are shown in Table 2. (4) Take the department-responsibility as the mining data, and combine the mining data of all local governments into a data set. The data set contains 627 mining data.

| Livestock breeding pollution control action                                                                 | Abbreviation |
|-----------------------------------------------------------------------------------------------------------|--------------|
| Strictly implement the environmental assessment system for large-scale livestock breeding                  | Action1      |
| Improve the livestock breeding pollution supervision system                                             | Action2      |
| Establish a territorial management responsibility system                                                 | Action3      |
| Implement the main responsibility system of large-scale farms                                            | Action4      |
| Improve performance evaluation and assessment system                                                    | Action5      |
| Build a cycle of planting and breeding development mechanism                                            | Action6      |
| Strengthen fiscal and taxation policy support                                                            | Action7      |
| Coordinate the solution of land and electricity use problems                                             | Action8      |
| Accelerate the transformation and upgrading of animal husbandry                                         | Action9      |
| Strengthen technology and equipment support                                                              | Action10     |

Table 2. The codes of local government departments.

| Local government departments                                                  | Abbreviation |
|--------------------------------------------------------------------------------|--------------|
| Department of Ecology and Environment                                        | D1           |
| Department of Agriculture and Rural Affairs                                   | D2           |
| Department of Finance                                                         | D3           |
| Department of Science and Technology                                          | D4           |
| Department of Natural Resources                                               | D5           |
| Department of Development and Reform                                          | D6           |

2.2. Methods

2.2.1. Measurement of livestock manure production. This study determines the amount of livestock raised according to the growth cycle of the livestock. The growth cycle of pigs is 199 days, the feeding amount is the number of slaughters that year, and the growth cycle of cattle and sheep exceeds one year, and the feeding amount is the number of slaughters at the end of the year. The manure excretion coefficients of pigs, cattle and sheep are 5.3kg/d, 12.4t/a, and 0.87t/a[9], and the annual manure production of livestock is:

\[ Q = N \cdot T \cdot P \]  

Among them, Q is the annual fecal production, N is the feeding amount, T is the feeding period, and P is the excretion coefficient.
2.2.2. Association rule mining. Use the R language and the Apriori algorithm in the arules tool to mine the association rules of the data set, and departmental collaboration relationships in the action transmission.

2.2.3. Correlation analysis. Through the relevant analysis of the frequency of local governments’ actions, departments and departmental collaborations with the effect of livestock breeding pollution control, we can explore the impact of policy transmission on livestock breeding pollution control.

3. Policy transmission analysis

Policy transmission is the transmission of actions, which depends on actors. Therefore, to analyze the policy transmission, it is necessary to analyze the transmission of actions and actors.

3.1. Action transmission analysis

In order to investigate the impact of action transmission on the effect of livestock breeding pollution control, this study firstly analyzes the frequency of them, as shown in Table 3 below:

| Action   | Correlation coefficient | P Value | Action   | Correlation coefficient | P Value |
|----------|------------------------|---------|----------|------------------------|---------|
| Overall  | 0.285                  | 0.037   | Action6  | 0.234                  | 0.034   |
| Action1  | 0.249                  | 0.047   | Action7  |                        |         |
| Action2  |                        |         | Action8  | 0.005                  | 0.578   |
| Action3  | 0.228                  | 0.045   | Action9  | 0.126                  | 0.457   |
| Action4  | 0.126                  | 0.257   | Action10 | 0.108                  | 0.523   |
| Action5  | 0.153                  | 0.365   |          |                        |         |

From the perspective of the action system, it is found that there is a significant positive correlation between the frequency of actions and the effect of livestock pollution control, indicating that the more the number of actions passed in the policy transmission, the better the effect. In view of specific actions, it is found that improving the livestock breeding pollution supervision system and strengthening fiscal and taxation policy support have been passed on to all local governments, so the correlation coefficients are not shown. In the remaining actions, correlation coefficients between the frequency of actions and the governance effect are positive, indicating that the transmission of actions is beneficial to improving the effect. Among them, strictly implementing the environmental assessment system for large-scale livestock breeding, establishing a territorial management responsibility system, and building a cycle of planting and breeding development mechanism all have significant positive correlations, meaning that strengthening the transmission of these actions can significantly improve the effect of livestock breeding pollution control.

3.2. Analysis on the collaboration of actors

In order to investigate the impact of the number of actors involved in the transmission of actions on the governance effect, this study correlates the frequency of actors and the effect of livestock breeding pollution control, as shown in Table 4 below:

| Action   | Correlation coefficient | P Value | Action   | Correlation coefficient | P Value |
|----------|------------------------|---------|----------|------------------------|---------|
| Overall  | 0.381                  | 0.020   | Action6  | 0.289                  | 0.037   |
| Action1  | 0.004                  | 0.381   | Action7  | 0.292                  | 0.039   |
| Action2  | 0.105                  | 0.237   | Action8  | 0.365                  | 0.026   |
| Action3  | 0.085                  | 0.617   | Action9  | 0.249                  | 0.047   |
| Action4  | 0.080                  | 0.638   | Action10 | 0.130                  | 0.443   |
| Action5  | 0.192                  | 0.255   |          |                        |         |
From the perspective of the action system, it is found that there is a significant positive correlation between the frequency of actors and pollution control effect of livestock breeding, revealing that the more actors participate, or the greater the degree of departmental collaborations, the better pollution control effect of livestock breeding. In other hand, in terms of specific actions, it is found that the correlation coefficient between the frequency of actors in all actions and the effect is positive, indicating that the collaboration of actors in all actions has a positive impact. The frequency of actors in building a cycle of planting and breeding development mechanism, strengthening fiscal and taxation policy support, coordinating the solution of land and electricity use problems, and accelerating the transformation and upgrading of animal husbandry therein respectively has a significant positive correlation with the effect, proving that strengthening the number of actors involved in these actions, or strengthening the departmental collaboration, can significantly improve the governance effect.

To analyze the specific departmental collaborations that should be strengthened, it is necessary to further analyze the related analysis between specific departmental collaborations and the governance effect. As shown in Table 5 below:

| Departmental collaboration | Action6 | Action7 | Action8 | Action9 |
|---------------------------|---------|---------|---------|---------|
| D2-D5                     | 0.540   | 0.008   |         |         |
| D1-D5                     | 0.598   | 0.003   |         |         |
| D2-D4                     | 0.507   | 0.014   | 0.507   | 0.014   |
| D1-D4                     | 0.507   | 0.014   | 0.507   | 0.014   |
| D5-D4                     | 0.507   | 0.014   | 0.507   | 0.014   |
| D3-D4                     | 0.507   | 0.014   | 0.507   | 0.014   |
| D6-D4                     | 0.507   | 0.014   | 0.507   | 0.014   |
| D5-D3                     |         |         | 0.507   | 0.014   |
| D5-D6                     |         |         | 0.507   | 0.014   |

The results show that in building a cycle of planting and breeding development mechanism, the collaboration between Department of Natural Resources and Department of Agriculture and Rural Affairs, as well as Department of Ecology and Environment, respectively have a significant positive correlation with the governance effect, which should be strengthened. This is owing to that the action requires land-based livestock to coordinate the layout of the planting and breeding industry, and livestock breeding is inseparable from forests and grasslands, so strengthening collaboration with Department of Natural Resources can significantly improve the effect. In the process of strengthening fiscal and taxation policy support and coordinating the solution of land and electricity use problems, the collaboration between Department of Science and Technology and the other 4 departments should also be strengthened thanks to a significant positive correlation. The outcome is because of the need to provide support for high-tech agricultural machinery and livestock breeding pollution treatment equipment in strengthening fiscal and taxation policy support. Coordinating the solution of land and electricity use problems also requires the promotion of high-tech livestock breeding waste utilization facilities and organic fertilizer. We can know that reinforce the collaboration with Department of Science and Technology can significantly raise the governance effect. In accelerating the transformation and upgrading of animal husbandry, the collaboration between Department of Finance and Department of Natural Resources, Department of Development and Reform and Department of Natural Resources need to be strengthened, as they have a significant positive correlation with the effect. This is in that accelerating the transformation and upgrading of animal husbandry requires optimizing the layout of livestock breeding and moving to areas with large environmental capacity. The effect will be enhanced through strengthening the collaboration with Department of Natural Resources.
4. Conclusions
A policy is an action plan composed of many actions. According to Parsons’ theory of structure and function, actions constitute an action system. The social structure is based on the action system, and the lack of action in policy transmission will lead to the lack of action system changing the social structure, and ultimately affect the realization of functions, so policy transmission must first consider the transmission of action that depends on the actors. In accordance with the synergy theory, the collaboration of actors can improve the efficiency of policy implementation and can also affect the realization of functions. Therefore, policy transmission must take into account not only the transmission of actions, but also the collaboration of actors to achieve the goal of enhancing public interest.

This study shows that the better the transmission of actions in policy transmission, the better the effect of livestock breeding pollution control. Among them, strictly implementing the environmental assessment system for large-scale livestock breeding, establishing a territorial management responsibility system, and building a cycle of planting and breeding development mechanism can significantly improve the effect of livestock breeding pollution control. While the greater the number of actors involved in the process of action transmission, the better the effect of livestock breeding pollution control. Among them, the number of actors participating in building a cycle of planting and breeding development mechanism, strengthening fiscal and taxation policy support, coordinating the solution of land and electricity use problems, and accelerating the transformation and upgrading of animal husbandry can significantly improve the effect. Further analysis shows that strengthening the collaboration with Department of Natural Resources in building a cycle of planting and breeding development mechanism, accelerating the transformation and upgrading of animal husbandry can obviously raise the effect of livestock breeding pollution control. It shows simultaneously that intensifying the collaboration with Department of Science and Technology in the actions of strengthening fiscal and taxation policy support and coordinating the solution of land and electricity use problems can also improve the effect significantly.

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References
[1] Luo, JM., Li, C., Liu, Y. (2001) An empirical analysis of the signal transmission effect of dividend policy of listed companies. The Theory and Practice of Finance and Economics., 51: 90–92.
[2] Chen, BJ., Mi, YS. (2019) Arbitrage constraint, policy signal transmission and market benchmark interest rate forming. Finance and Accounting Monthly., 10: 126–131.
[3] Wei, J. (2008) Research on the quality of public policy transmission. Social Sciences Review., 3: 55–59.
[4] Xue, L., Tang, LY. (2009) Game analysis and enlightenment of bureaucratic loss in the process of public policy transmission. Jiangxi Social Sciences., 8: 197–202.
[5] Yu, GX., Zeng, GJ. (2019) The rheology research of special small town policy text transmission: based on content analysis method. Urban Development Studies., 5: 102–109.
[6] Parsons, T. (1967) The Structure Of Social Action. Free Press Publishing, New York.
[7] Zadek, S. (2008) Global collaborative governance: there is no alternative. Corporate Governance International Journal of Business in Society., 8: 374–388.
[8] Hoel, M. (1997) Coordination of environmental policy for transboundary environmental problems?. Journal of Public Economics., 66: 199–224.
[9] Wang, FH., Ma, WQ. Dou, ZX. Ma, Lin. Liu, XL. Xu, JX. Zhang, FS. (2006) The estimation of the production amount of animal manure and its environmental effect in China. China Environmental Science., 5: 614–617.