Research on Scientific Strategy and Technology of Agricultural Non-point Source Pollution Control

Jinli Tang
School of Marxism, Yuxi Normal University, YunNan, 653100, China
tjl@yxnu.edu.cn

Abstract. In order to explore expansion of agricultural non-point source pollution in China is mainly related to excessive use of chemical fertilizers and pesticides, backward fertilization methods, low utilization of organic waste in the aquaculture industry, insufficient promotion of advanced agricultural technologies, and relatively weak public environmental awareness. This article focuses on the research directions of agricultural and rural pollution control and environmental protection, efficient recycling of fertilizer resources, and environmental control of production areas, and carries out related technical and environmental engineering constructions. In this paper, in the process of fully grasping the growth of crops, we will increase the technical research on environmental engineering. This article studies the use of effective environmental regulation engineering technology to develop the agricultural.

Key words. Agricultural production, pollution control, cointegration test, empirical research.

1. Introduction
Chinese agriculture implements the "high-yield, high-quality, high-efficiency" development policy, and vigorously promotes agricultural production with the core goal of increasing production. The input of agricultural materials such as fertilizers, pesticides, and agricultural membranes has been greatly improved. With the improvement of living standards, the scale of livestock and poultry farming has continued to expand; while achieving the goal of increasing production and income, agricultural non-point source pollution has continued to intensify, and the agricultural environment is facing the dual threats of large-scale ecological degradation and agricultural pollution. So far, the depth and breadth of China's agricultural non-point source pollution has far exceeded that of developed countries, and the potential pollution pressure is unmatched by other countries. The impact of the deterioration of the agricultural production environment on China's food production capacity and food security has also appeared. The prevention and control of agricultural non-point source pollution is a fundamental public cause that has a profound impact on the safety and health of the people's lives. At present, due to restrictions on China's economic development level and people's level of understanding, the problem of agricultural non-point source pollution has not been effectively resolved. Therefore, it is urgent to establish and improve the policies and technical systems for agricultural non-point source pollution prevention and control.
2. There is a long way to go to prevent and control agricultural non-point source pollution
Theoretical research and production practices at home and abroad have proved that the treatment of agricultural non-point source pollution is much more difficult than point source pollution [1]. The former involves a wide range of people and involves many people. Therefore, whether it is government departments, researchers, or the general public, they should be prepared for long-term hard work in the management of agricultural non-point source pollution.

2.1. The complexity of the causes of agricultural non-point source pollution
Like point source pollution, agricultural non-point source pollution also occurs in the production process. However, compared with point source pollution, agricultural non-point source pollution has a larger space-time range and a more complex mechanism of occurrence. It is not only affected by human activities, but also by natural factors; the randomness of the time and place of occurrence, and the intermittent nature of the way of occurrence, The uncertainty of emission methods and pathways, the spatiotemporal variability of pollution loads, and the difficulty of monitoring, simulation and control. All these have brought great difficulties to the treatment of agricultural non-point source pollution[2].

2.2. Difficulties of Agricultural Non-point Source Pollution Control in China
Agricultural non-point source pollution occurs during the agricultural production process. Some developed countries with rich arable land resources can control nutrient loss by returning farmland to forest, returning farmland to grass, and reducing the application of fertilizers. However, China is a developing country with insufficient cultivated land resources. It is almost impossible to exchange environmental safety by sacrificing production, returning farmland to forests, returning farmland to grasses, and greatly reducing the application of fertilizers. Moreover, in order to achieve the goal of increasing production and income, under the condition that it is difficult to change the cultivation technology in the short term, a large amount of chemical fertilizer input is still inevitable[3].

2.3. It is difficult to identify the main body of small-scale pollution
The subject. This decentralized operation model has exacerbated the randomness of the time and place of agricultural non-point source pollution, the uncertainty of emission methods and pathways, the spatiotemporal variation of pollution load, the difficulty of monitoring, simulation and control, and the increase of agricultural non-point source. Cost and difficulty of pollution control technology promotion.
At the same time, due to the small scale of rural operations in China and the dominance of family-based operations, it is difficult to determine the main body of pollution in the actual pollution inspection, and it is difficult to accurately define the responsibility for environmental pollution and governance, which makes the rural environment without a main body when polluted. To bear, in the end, the government can only pay the bills, resulting in a waste of public resources.

2.4. Farmers' weak awareness of agricultural non-point source pollution prevention
Modern agricultural production is almost inseparable from the input of pesticides and fertilizers. It is almost impossible for agricultural production to be completely pollution-free. Reducing pollution is not something that governments or scientists can do independently. It requires public participation. Farmers play an important role. However, due to the influence of traditional concepts, Chinese farmers have always been content with adequate food and clothing, and they only care about immediate interests and have no long-term plans. Farmers' environmental awareness and rights protection are generally not high, and they do not fully understand the dangers of environmental pollution and damage; even if they realize that the harmfulness of the environment, I do not know what kind of rights I have and how to protect my rights and interests. Coupled with the lack of scientific and cultural knowledge, generally no attention has been paid to the problem of rural self-pollution [4]. Raising public environmental awareness requires a longer process.

![Figure 2](image_url)

**Figure 2.** Analysis of Thoughts on Prevention and Control of Agricultural Non-point Source Pollution

3. Farmers are the technology of agricultural non-point source pollution prevention and control
Non-point source pollution is more related to agriculture, rural areas and farmers, mainly including pesticides, fertilizers, intensive breeding farms and rural sewage and garbage pollution. Therefore, agricultural non-point source pollution involves thousands of households, and planting, breeding, and dwellings are all important sources of agricultural non-point source pollution. Millions of households are actually producers of agricultural non-point source pollution. Therefore, agriculture The prevention and control of non-point source pollution must also involve the participation of many farmers to be truly implemented. Since the end of the last century, the state and local governments have invested a lot of funds in the treatment of agricultural non-point source pollution and conducted demonstrations of
different-scale agricultural non-point source pollution control, but the effect is not obvious. The low participation of farmers is also an important reason. In the treatment of agricultural non-point source pollution, the government, scientific and technical personnel, and farmers must clarify their roles. Farmers are the main force in the prevention and control of agricultural non-point source pollution. Only the true participation of all farmers is required to control agricultural non-point source pollution in China. Only when there is real hope can we eliminate pollution while treating it. Government departments are the makers of agricultural non-point source pollution control policies. Their main responsibilities are to lead and guide the role, perform planning, provide systems, supervise implementation, performance evaluation, information services, major technology development, goodwill rent establishment, and circular economy ideology. Construction and other functions; the main responsibility of scientific and technological personnel is to develop technology and promote technology. They cannot completely replace the role of farmers. In the process of preventing and controlling agricultural non-point source pollution, the government should encourage and promote farmers to adopt effective technology and management experience, and pay more attention to giving play to the role of farmers. Therefore, in order to effectively implement agricultural non-point source pollution prevention and control, the social participation mechanism for agricultural non-point source pollution prevention and control should be continuously improved. Improve farmers' awareness of environmental protection and participation, consciously participate in the prevention and control of agricultural non-point source pollution, proactively adopt environmentally-friendly agricultural production technologies; optimize relevant policy conditions, give play to the professional advantages of non-governmental environmental organizations, and encourage non-governmental organizations to participate in the Prevention.

4. Empirical analysis

4.1. Stationarity test (ADF test)

In order to test the stability of the time series, a unit root test is performed on the time series pollution index and LGDP. If the k order difference $\Delta X_t$ of the non-stationary time series $X_t$ is stationary, then the time series $X_t$ is an EEK-order single integer process with a unit root. Because the unit root test relies heavily on the choice of lag terms, we usually use the rule of thumb to determine the number of lag terms. The test results are shown in Table 1:

| variable    | ADF test value | Inspection type | Critical value (1%, 5%) | in conclusion |
|-------------|----------------|-----------------|-------------------------|---------------|
| pollution index | 5.9943         | (0, 0, 0)       | -2.6026                 | -1.9462       | unstable |
| LGDP        | 9.4621         | (0, 0, 0)       | -2.6026                 | -1.9462       | unstable |
| pollution index | -3.3449    | (0, 0, 0)       | -2.6033                 | -1.9463       | smooth  |
| Δ LGDP       | -5.1958        | (c, 0, 0)       | -3.5478                 | -2.9127       | smooth  |
| Δ Δ LGDP     | -5.6384        | (c, t, 0)       | -4.1249                 | -3.4889       | smooth  |
| Δ Δ Δ LGDP   | -3.0529        | (0, 0, 0)       | -2.6033                 | -1.9463       | smooth  |
| Δ Δ Δ Δ LGDP | -5.3433        | (c, 0, 0)       | -3.5478                 | -2.9127       | smooth  |
| Δ Δ Δ Δ Δ LGDP | -5.7900    | (c, t, 0)       | -4.1249                 | -3.4889       | smooth  |

Note: All the test results in this article are from the software Eviews3.1; $\Delta$ represents the first-order difference of the variables', t, and k in the test form represent the constant term, the trend term, and the lag order used.

The test results show that at the significance level of 1% and 5%, the null hypothesis that $\Delta$ the pollution index and Δ LGDP have a unit root $\rho = 1$ is rejected, indicating that both the $\Delta$ pollution index and Δ LGDP are stationary time series, and both are first-order and single-integrated, consistent with Conditions for cointegration analysis.
4.2. Co-integration test

In order to determine whether there is a long-term stable proportional relationship between the national agricultural production value and the national total output value, that is, the cointegration relationship, a cointegration test needs to be performed. It is known from the ADF test that although the time series LRGDP and LRAGP are non-stationary, they are both first-order single integer series, and there may be some stable linear combination. This combination reflects the long-term stable proportional relationship between the variables. The E-G two-step method was used to perform co-integration tests on two variables, LRGDP and LRAGP. First, the E-G method was used for analysis. The estimated co-integration regression model was:

\[
(LGDP)_t = -0.9342 + 1.91(LAGDP)_t + \varepsilon_t \tag{1}
\]

In order to determine whether there is a co-integration relationship between the LGDP and pollution index series, it is necessary to test the stability of the residual sequence \( \varepsilon_t \) of formula (1). The ADF test was performed on the residuals of the regression equation (1). The results are shown in Table 2.

| variable | ADF test value | Inspection type | Critical value (1%, 5%,) | D.W | in conclusion |
|----------|----------------|-----------------|--------------------------|-----|--------------|
| \( \varepsilon_t \) | -8.7522 | (0, 0, 0) | -4.1249 | -3.4889 | 2.063 | I (0) |

The test results show that at the significance level of 1% and 5%, the null hypothesis that the least squares residual is non-stationary is rejected, and the residual sequence is determined to be stationary. We believe that China's economic growth LGDP and agricultural gross output value LGDP are co-integrated, indicating that there is a long-term equilibrium relationship between these variables, and regression analysis is correct. It can be seen from the regression equation (1) that the regression coefficient \( t = 4.673 \), which passed the t test; the fitting degree is 0.9997, which shows that the regression effect is quite good as a whole; it also shows that there is a high correlation between LGDP and pollution index. Assuming other conditions remain unchanged, the elasticity of the national GDP to agricultural output value is 1.91, that is, every 1% increase in agricultural output value will promote economic growth of 1.91%. The role of agricultural development in driving economic growth is quite large, which also provides a theoretical basis for the provincial Party committee and the provincial government to attach importance to agricultural production.

4.3. Granger causality test

The cointegration test results prove that there is a long-term stable equilibrium relationship between agricultural development and economic growth in China, but whether this equilibrium relationship constitutes a causal relationship needs further testing. We use the causality test proposed by Granger to analyse this problem. The parameter model of the test is as follows:

\[
(LGDP)_t = \alpha_{10} + \sum_{j=0}^{m} \beta_{1j} (LAGDP)_{t-j} + \varepsilon_{1t} \tag{2}
\]

\[
(LAGDP)_t = \alpha_{20} + \sum_{j=0}^{n} \beta_{2j} (LGDP)_{t-j} + \varepsilon_{2t} \tag{3}
\]

Among them, \( m, n \) respectively represent the optimal lag order of the model, and \( \varepsilon_{it} (i=1,2) \) is the white noise sequence. The significance of the coefficients in equations (2) and (3) corresponds to the Granger causality between variables. For equation (2), give the hypothesis:

\[
\begin{align*}
H_0: \beta_{1j} = 0 \\
H_1: \beta_{1j} \neq 0 & \text{ for } j = 1, 2, 3, \ldots, m
\end{align*}
\]
If the null hypothesis $H_0$ holds, it means that all previous changes in national agricultural production have no ability to explain or predict national economic growth. At this time, it is believed that changes in national agricultural development have no significant Granger effect on national economic growth. According to the Akaike Information Criterion (AIC), the lag order of the two variables is two, and the Granger causality test results for the two variables are shown in Table 3.

### Table 3. Granger causality test.

| Null hypothesis                          | Lag number | F statistic | P value | in conclusion   |
|----------------------------------------|------------|------------|---------|-----------------|
| LGDP is not the Granger cause of pollution index | 2          | 33.5203    | 0.0000  | Refuse $H_0$    |
| Pollution Index Is Not Granger Cause of LGDP | 2          | 8.8465     | 0.0005  | Refuse $H_0$    |

It can be seen from Table 3 that under the significance level of 5%, there is a two-way Granger causality between the development of agricultural production and economic growth in China. This confirms that the development of agricultural production in China has promoted the national economic growth. Economic growth has provided favourable conditions for increasing agricultural fiscal expenditures, improving agricultural production conditions, and promoting agricultural scientific and technological innovation, which in turn has promoted the development of agricultural production in China. Thus, formed a virtuous circle of mutual promotion between the development of agricultural production and economic growth in China.

#### 4.4. Impulse response function analysis

The impulse response function IRF is used to measure the impact of a standard deviation shock from a random disturbance term on the current and future values of endogenous variables, showing how the disturbance of any one variable affects all other variables through the model, and finally returns to itself. The random disturbance terms in the model are called innovations. If the innovations are related, they will contain common components that are not associated with a specific variable, and the effects of the common components will be attributed to the first variable that appears in the VAR system. Next, a two-variable VAR (3) model is established. The analysis of the impulse response function is shown in Figure 1 and Figure 2. In the figure, the horizontal axis represents the number of lags of impact (unit: annual), and the vertical axis represents the change in growth rate.

![Figure 3. Overall effect of agricultural non-point source pollution prevention and environmental protection in China](image-url)
From Figure 4 given the impact of a 1% increase in agricultural production growth rate, the national GDP grew rapidly in the early period and reached the highest in the second year, about 0.075%, and then stabilized after a small fluctuation. This shows that agricultural production is subject to a certain shock from external conditions, and it has a same-direction impact on the national GDP, and this shock has a significant promotion effect and a long-lasting effect. It can be seen from Figure 5 that the impact on the national GDP growth rate by 1 percentage point, and the same impact on agricultural production, gradually increased, reaching the maximum in the seventh period, about 0.09%, agricultural production is fluctuating It then stabilized, and this shock also had a significant promotion effect and a longer lasting effect [2].

Figure 4. Analysis of China's agricultural environmental protection data.

4.5. In the future, China will develop simple and low-cost alternative technologies suitable for farmers to use
The focus on establishing soil testing formula fertilization and pesticide technology systems with different climates, soils, and crop conditions, and encourage farmers to use organic fertilizers; adopt no-tillage and other technologies such as buffering Farmland protection technologies such as ecological belts and ecological ditches to reduce nutrient and pesticide loss caused by soil erosion; adopt technologies such as ecological wetlands, ecological ditches and ecological isolation belts, especially to develop ecological technologies suitable for the control of pollutants in rural China and farmland, drawing on foreign countries The practical experience of advanced countries in developing organic agriculture, ecological agriculture, and green agriculture, and controlling non-point source pollution from farmland. The second is to establish various standardized agricultural operating procedures (including limited agricultural production technical standards), regulate farmland fertilization methods, time, types and quantities, and reduce nutrient loss from sources, processes, etc .; establish strict types of fertilizers and pesticides as soon as possible Operating procedures. At the same time, we should focus on policies that are compatible with China ’s agricultural non-point source pollution control policies, and support technology development research. On this basis, strengthen the training of pollution prevention technology and the construction of extension systems, so that farmers can master the knowledge and skills of agricultural non-point source pollution prevention as soon as possible[5].

4.6. Promote classification and partition prevention and control at the right time and place
Due to the different formation mechanisms of different types of non-point source pollution, non-point source pollution from farmland, non-point source pollution from livestock and poultry farms, and non-point source pollution from residential areas should be classified and controlled to encourage the development of environmentally-friendly agricultural production technologies, and Replace the original technology. Based on the status quo of rural areas in China, for the agricultural non-point source pollution caused by farmland itself, source control strategies should be adopted to implement the best
nutrient management of farmland in the entire river basin to prevent excessive application of nitrogen and phosphorus fertilizers on farmland; relying on river basin management departments and rural agriculture Technology promotion system and establishment of supervision mechanism of origin control. For non-point source pollution caused by livestock and poultry farms, consideration should be given to promoting the return of livestock and poultry manure to the field at a lower cost, through technical transformation of transportation equipment, fertilizing equipment, and standardizing the application of organic fertilizers for farm animals and poultry. Improve the utilization of nutrients in livestock and poultry manure, and reduce the loss of nitrogen and phosphorus in surface runoff in livestock and poultry farms. For non-point source pollution in rural residential areas, the core problem is to strengthen the construction of sewage pipe networks through infrastructure construction and centralized treatment of sewage.

5. Conclusion
When implementing non-point source pollution prevention and control, due to the different environmental requirements of water functional areas in different regions, the specific strategies to be implemented should also be different. As the environmental requirements of environmental functional areas increase, the measures they adopt should also become more stringent. Based on the needs of environmental protection, the environmental protection zones at different levels should be reasonably demarcated, and the limited farmland production technical standards for environmental conservation areas and environmental protection zones should be formulated and tested.

Acknowledgments
The research result of the 2018 project "study on agricultural non-point source pollution in Yunnan Plateau" of Yunnan Science and Technology Department, Item no.2018FH001-067

References
[1] Chen, D. Government’s responsibility for control of agricultural environmental pollution in china., 08(10) (2016) 41-43.
[2] Krishna P. Paudel, Nirmala Devkota, & Ying Tan. Best management practices adoption to mitigate non-point source pollution: a conditional frailty model. China Agricultural Economic Review, 8(4) (2016) 534-552.
[3] Haibin Han, Zhangqi Zhong, Yu Guo, Feng Xi, & Shuangliang Liu. Coupling and decoupling effects of agricultural carbon emissions in china and their driving factors. Environmental Science & Pollution Research International, 25(9) (2018) 1-14.
[4] Su, H. H., Hu, M. M., Harveysamuel, T., & Yang, Y. Z. Accumulation and excretion of cadmium in three successive generations of spodoptera exigua (lepidoptera: noctuidae) and impact on the population increase., 107(1) (2017) 223-9.
[5] S.E. Abd Elhafez, H. A. Hamad, A. A. Zaatout, & G. F. Malash. Management of agricultural waste for removal of heavy metals from aqueous solution: adsorption behaviors, adsorption mechanisms, environmental protection, and techno-economic analysis. Environmental Science & Pollution Research, 24(2) (2016) 1-19.