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# Situation, Problems and Governance Policies of Agriculture Related Pollution in China

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**Abstract:** Agriculture related pollutants have been thought as one of the dominant contributors to contamination of environmental systems, which have an increasing destructive effect and a rising emission trend, and baffle the sustainable development of agriculture, rural area and the whole national economy in China. The study first analyzed the situation of agricultural fertilizer and pesticide use and the livestock and poultry farming related emission, and then proceeded with the EKC study, finally explored evolution process of China's agriculture related environmental policies and the existing main disadvantages. Some policy-making issues are also discussed for pollution prevention. Implementing ecological agricultural engineering technology to develop ecological circular agriculture and breaking the urban-rural dual structure to realize the integration of urban and rural development are the core policies of agricultural sustainable development, with systematic use and extension of the rural methane project as crux of agricultural ecology in China.

## 1. Introduction

China's agricultural pollution problems have become increasingly prominent. The First National Pollution Source Survey Bulletin shows that the agriculture sourced COD, N and P accounted for 43.7%, 57.2% and 67.3% of the total national emissions, respectively. To some extent, the severity of agricultural pollution has surpassed industrial and urban discharges. It has been one of China's major sources of atmospheric, water and soil pollution, especially the main causes of water pollution in China [1-5].

Agriculture related pollution control is of global significance, as a worldwide conundrum [3, 4, 6-8]. The China's literature to agricultural pollution began in the late of 1990s [1, 2] and it gradually became the focus of widespread concern presently. For a long time, within the context of urban-rural dual structure and extensive production modes, agricultural pollution is increasingly becoming one of the most significant and prominent environmental problems, while Chinese small-scale farmers' production patterns make the agriculture pollution control in a difficult position. For a long time, environmental research and management systems have been mainly established based on the prevention of pollution in cities and important industrial point sources. At present, most of the relevant research focuses on the application of environmental science and other theoretical methods, from the technical and engineering level to the monitoring of pollutants for agricultural pollution and the use of non-point source pollution model assessment [5-8], but China's agricultural pollution prevention and control is a comprehensive systematic project. It is necessary to strengthen the comprehensive integration research of multidisciplinary theoretical methods such as geography, ecology, and economics. In recent years, China need to attach more importance to the issue of agricultural pollution.



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This study uses the heterogeneous panel cointegration technique to investigate the inverted U-shaped EKC hypothesis from 1988 to 2016, making it safer to assume that all cross-sections adhere to the same EKC [9, 10], and explores policy-making problems and discusses the policies of environmental degradation from the point of agricultural perspective.

## 2. Agriculture related pollution status in China

China is the world's largest fertilizer, pesticide, agricultural film user, also with low utilization rate and severe overdose application, and serious residual and diffusion, resulting in a large number of cultivated land and water system damage. The loss of nitrogen and phosphorus in farmland is the main cause of eutrophication of surface water and nitrate pollution of groundwater [2-5, 10-12], and is important contributor to local, regional and global environmental and ecosystem functions. Additionally, the amount of waste such as manure and urine in livestock and poultry farming far exceeds industrial solid waste, with a low harmless treatment rate, and most of that are directly discharged without any treatment. The annual emissions of CH<sub>4</sub> and N<sub>2</sub>O from agricultural sources account for more than 80% of the total national emissions, and become one of the main sources of greenhouse gases [12-14].

Table 1. The environmental Kuznets curve (EKC) of agricultural pollution in China

	chemical fertilizer use	livestock and poultry farming
C	-3.014*** -3.336	-5.845*** -11.873
per capita income	1.144*** 4.720	1.844*** 14.244
Square of per capita income	-0.057*** -3.385	-0.098*** -11.044
TP (CNY)	80,000	45,000

\*\*\* indicates statistical significance at the 1% level, respectively

Based on the agriculture related environmental and economic data of 31 provincial economies in China from 1988 to 2017, the environmental Kuznets curve (EKC) of agricultural pollution in China was investigated, using the panel unit root test, the cointegration test and panel-based dynamic OLS, which have the advantage of higher power and a more robust result with the short time spans of typical data sets. Herein, a standard EKC model is expressed as a logarithmic quadratic function of the income to examine whether the inverted U-shaped EKC relationship exists [9-11]. The EKC is defined as follows:

$$E_{it} = a + b_1 Y_{it} + b_2 Y_{it}^2 + b_3 O_{it} + e_{it}, \quad (1)$$

where  $E_{it}$  represents the state of pollutants of the economy  $i$  in year  $t$ ;  $Y_{it}$  represents per capita income of provincial economy  $i$  in year  $t$ ; and  $O_{it}$  represents the other variables that generate an impact on the environment.

It indicates that, for the chemical fertilizer related pollution variable, the EKC turning point of that were more than 80,000 RMB in per capita GDP., the EKC point of pollution variables in livestock and poultry farming is above 45,000 RMB per capita income. In recent years, China's relevant departments have done a lot of work in the control of agricultural pollution, such as the development of rural biogas project, vigorously promotion of soil testing and formula fertilization, and implement of rural clean-up projects, etc., and achieved relatively good results. But the agricultural pollution situation is still serious, and there are still growth trends in many regions, which have directly threatened food safety, agricultural trade, environmental health and the national ecological security, which have seriously hindered the sustainable development of agriculture, rural areas and the entire national economy.

### 3. Problems and challenges of China's agricultural pollution prevention

#### *3.1 Evolution process of agriculture related environmental governance in China*

With the growing problem of agricultural pollution, China's agricultural environmental management system and policies have gradually been formed and developed, and gradually incorporated into the government's environmental management framework.

China's agricultural environmental management system has experienced 4 stages: the initial stage (reform and opening to the mid-1990s), the initial development stage (mid-1990s to the early 21st century), and the start-up stage (2005-2012), and the comprehensive strategic promotion stage (2013-present).

On July 24, 2008, the State Council convened a national video conference on rural environmental protection work. This is the first national rural environmental protection conference held since the founding of New China. The Outline of the Thirteenth Five-Year Plan for National Economic and Social Development aims to reduce the discharge of major agricultural pollutants and make major arrangements for the comprehensive improvement of rural environment. In the past five years, the CPC Central Committee No. 1 document consequently listed rural environmental remediation as one of the major strategies.

The treatment of agricultural pollution has received great attention from relevant parties, such as governments, firms, farmers and NGOs. However, in the face of the complicated problems in rural China, the effectiveness and operability of policies in actual management need to be strengthened, and the systemic nature of agricultural pollution prevention and agricultural ecologicalization still be deeply considered. The corresponding environmental economic policies need to be improved.

#### *3.2 Major problems in the agricultural pollution prevention system*

For a long time, China's environmental management system has centered on urban and industrial point source pollution control, ignoring agricultural pollution prevention, resulting in the development of agricultural environmental management system lags behind the rural environment development. It can be considered that the problem of agricultural pollution is largely a product of the urban-rural dual structure, and to some extent strengthens this urban-rural dual structure. The agricultural pollution problem should be raised to a strategic height and treated as a major social problem.

*3.2.1 Agriculture environmental investment and monitoring mechanism is insufficient.* China's long-term dualistic structure of urban-rural division is the institutional root of the weakness of agricultural pollution prevention and control. As a result, public investment and infrastructure for environmental protection in rural areas are seriously scarce. There are no basically sewage centralized treatment facilities in most rural areas in China [2, 5, 12]. China's environmental protection investment accounts for a much lower proportion of GDP than that of western developed countries, not to mention in the same growth stages. The investment in agricultural pollution control is even worse, and so rural environmental protection work cannot be effectively carried out. Compared with industrial point source pollution, there is no basic information platform on the distribution and status of agricultural non-point source pollution in China. China has not yet established a systematic environmental monitoring system, especially for periodic bulletin system for agricultural pollution. At present, the control of agricultural pollution is mainly at the regional level such as the whole regional and the major river basins. There is a lack of rigid constraints on rural environmental protection objectives in government performance evaluation. China's most basic environmental protection system is a county-level environmental agency. However, most towns and villages lack protection organizations.

*3.2.2 Agriculture environmental policy is insufficient.* The comprehensive and professional environmental management system for agricultural pollution need to be strengthened. Many policies do not fully take into account the actual conditions and needs of farmers, and especially lack effective environmental economic incentives. The environmental pollution prevention legislation is mainly

aimed at urban and industrial point source pollution. Many agricultural pollution control regulations need to be strengthened. In many cases, agricultural non-point source pollution prevention is ultimately only an initiative or even only a kind of ecological declaration. In the fields of agricultural pollution control in China, it is mainly based on the administrative control of the imperative means and the end treatment as the main way of rural environmental protection. Due to information, cost, system and other issues, it is not suitable for agricultural pollution control, especially China, in such a dispersed smallholder production model. As some developed countries experiences, governance in pollution sources should be the main governance model in the coming period. It should be vigorously advocated for the development model of agricultural ecological development and the circular economy. China's public participation means in environmental governance is obviously insufficient in both development and application forms, especially for agricultural pollution prevention, ignoring the base role of farmers in agricultural pollution prevention and agricultural ecology. This is a key factor restricting the governance of agricultural pollution. Under the context of current small-scale peasant economy model in China, the farming household contract responsibility system is weakened, and the subjective role of peasant participation mechanism should be strengthened in the design of legislation and related policy measures.

#### **4. Conclusions and Policy Discussion**

The prevention and control of agricultural pollution and the development of agricultural ecologicalization are a systematic project and require tangible efforts, from the points of governments, entrepreneurs, and farmers, and the NGOs. The main pressures of agricultural pollution come from the use of agricultural fertilizers, pesticides and livestock and poultry breeding. In the future, livestock and poultry farming, its excreta treatment and the energy-environmental engineering, and nutrient management should be considered and planned systematically and unitedly, with coordination in various aspects. Vigorously implementing ecological agriculture engineering technology and developing ecological recycling agriculture are undoubtedly the significant means to solve this problem. The comprehensive application and systematic promotion of biogas engineering are the key link of China's agricultural ecology and sustainable development.

By exploring the waste of livestock and poultry farming and crop planting as raw materials, integrating biogas power generation, organic fertilizer production of biogas residue as support for organic planting and livestock and poultry feeding, this kind of large-scale eco-agricultural system project will be helpful to comprehensively improve the greening and modernization level of agricultural production and effectively control non-point source pollution, which has broad application prospects, especially developing rural China. This ecological and modern agricultural engineering mode should be developed step-by-step, beginning from large-scale aquaculture plants and large-scale agricultural land pilot projects, then gradually to various farmer households and sporadic agricultural units. The entire agricultural production industry chain is based on the treatment of agricultural wastes and the biogas project, in order to produce organic food, and transform chemistry-based and extensive agriculture into green ecological agriculture. Some counties might be selected to build a circular agro-ecological experiment park. The experimental park includes modern agricultural areas, ecological breeding areas, agricultural product processing areas, agricultural high-tech industrial areas, new village living areas and ecology tourism areas, as a pilot demonstration park of agricultural circular economy embodying the characteristics of modern agriculture, the pioneering zone for the integrated development of urban and rural areas, the demonstration zone for the countryside revitalization [2-4]. It should be vigorously promoted for the four-one agricultural recycling system and energy-ecological agricultural engineering including planting, poultry farming, product processing and biogas engineering.

Furthermore, the long-term urban-rural dual structure and related institutional problems have led to the marginalization of agriculture issues and its marginalization of environmental governance. The government should systematically establish and improve laws, regulations and standards related to the content of agricultural non-point source pollution prevention, from the actual development mechanism

of rural development and environmental protection in different regions. The functions of various departments on agricultural environmental protection should be clarified, based on the participation of various relevant government departments such as the aspects of agriculture, environmental, energy, water conservancy, and the land. The incentive mechanism for the county and township grassroots governments should be adjusted, setting up rigid agricultural pollution prevention and agricultural green ecological contents in the government assessment indicators, fundamentally changing the development view of governments at all levels and the long-established urban preferences. And, the financial support for agricultural pollution control should be increased, with a fair, just and reasonable allocation of funds and other pollution prevention resources, at least putting agricultural pollution control at the same level as industrial point source pollution. A systematic agricultural and rural pollution monitoring system should be established, and incorporate it into the existing routine environmental monitoring system and environmental information database, by conducting a deeper and wider survey of the water environment, soil environment and quality of agricultural products in rural areas.

Additionally, a single type of administrative means and state investment cannot solve the problem of agricultural pollution. It should be strengthened to research and propose systematic environmental and economic measures as well as voluntary social measures. On the basis of ensuring agricultural security, it should be paid close attention to various societies such as farmer households, focusing on ecological equity and eco-efficiency.

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