

Research on Ecological Compensation Mechanism for Preventing Agricultural Non-point Source Pollution

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Abstract. Agricultural non-point source (NPS) pollution has become the bottleneck of modern agricultural development. Ecological compensation can realize the internalization of external cost of ecosystem caused by human activities. In this study, through the analysis on theoretical basis and formation mechanism of agricultural NPS pollution, ecological compensation mechanism was constructed.

Keywords: Agricultural NPS Pollution; Ecological Compensation Mechanism; Externality

1. Introduction

Because of the wide range, long latency period and complex uncertainties involved in simulation processes, agricultural nonpoint source (NPS) pollution has become a primary threat to environmental health. Ecological construction or environmental protection is a kind of socioeconomic activity with positive externality, which often are provided directly by the government as public goods in fact. To internalize income or compensating for external costs, the concept of Ecological Compensation is proposed. According to utilitarians, the producer may be required to pay all all of the real costs of production. A problem with this way is that there are large number of farms in China, which means that several polluters are involved, and it is difficult to identify who is being harmed and by whom. Although the farmers are the main emitters, they are also the direct victims of the pollution consequences [1]. There are few literature on compensation mechanism of agricultural NPS pollution in China, current research analyzes farmers' willingness to accept for compensation[2,3]. In this paper, the theoretical basis and formation mechanism of agricultural NPS pollution compensation was analyzed, and on this basis, the framework of agricultural NPS pollution ecological compensation mechanism was designed.

2. Theoretical basis of agricultural NPS ecological compensation mechanism

2.1. Ecological Environment Value Theory

The ecological environment value theory is the value basis and measurement reference for the construction of agricultural NPS pollution prevention mechanism. Human beings depend on nature. The ecological environment value theory considers : the resource and ecological environment are scarce and valuable, we need pay for using. As a kind of resource, the rural ecological environment is not only the carrier of rural residents' living and agricultural production, but also the key to agricultural production. As an indispensable resource element, the rural ecological environment is impossible to supply infinitely in quantity and quality. With the development of society, agricultural NPS pollution is increasing, the ecological environment damage to rural areas is intensifying, and the natural environment suitable for human survival is increasingly scarce. This scarcity is the value of the ecological environment. Carrying out ecological prevention of agricultural NPS pollution, repairing rural ecological environment system, and enhancing rural ecosystem service function are the basis for ensuring rural residents' living well, agricultural development, food safety and social progress.

2.2. External effect theory

The external effect theory can explain the formation of agricultural NPS pollution, and the internalization of external effects is the basic idea of the construction of agricultural NPS pollution ecological compensation mechanism. Externality means that the activities of some economic entities will have an impact on other economic entities, but this potential impact will not be reflected in the market transaction or price system, resulting in the social resource allocation not reaching the Pareto optimal state. As an important theoretical basis for agricultural NPS pollution prevention and ecological environmental protection policy formulation, externality has been widely applied in many fields, and has achieved good results, such as compensation for returning farmland to forests, sewage charges, water resources fees, etc. The definition of property rights in rural environment and resources is not clear, environmental benefits cannot be assessed, and the cost of paying for pollution is almost zero, thus causing agricultural NPS pollution. In the process of agricultural NPS pollution from formation to governance, externalities are mainly reflected in two aspects: on the one hand, the negative externalities brought about by non-green lifestyles and unclean production activities; on the other hand, the

positive externalities brought about by effective agricultural NPS pollution prevention and control. Based on the above, the idea of NPS pollution control is to charge or collect taxes on agricultural producers that damage the ecological resources environment, and to compensate agricultural producers who protect the ecological resources environment. These measures will increase the agricultural producers' destroying costs or prevention gains to eliminate the distortion of externalities on resource allocation.

2.3. Public Goods Theory

Samuelson defines a public good as "one which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good"[4]. In reality, the rural ecological environment system and the ecological services it provides are quasi-public goods and cannot be traded through market mechanisms. On the one hand, agricultural NPS pollution control is the unanimous and universal interest appeal of the masses; on the other hand, the supply of good rural ecological environment involves the distribution of interests and costs of various entities. There is a game of interest in the prevention and control of agricultural NPS pollution, and it is prone to "prisoner's dilemma." When agricultural NPS pollution control lacks motivation, the willingness of each entity to assume obligations is insufficient, which ultimately leads to the failure of public goods supply. Therefore, it is particularly urgent to adjust the interest relationship between eco-service providers and eco-service beneficiaries and to establish an effective and flexible agricultural NPS pollution ecological compensation mechanism.

3. Formation mechanism of agricultural NPS pollution

3.1. Sources of agricultural NPS pollution

Agricultural NPS pollution stems from the highly negative externalities of production activities. First, crop producers engage in self-interested activities with negative externalities, which lead to farmland nitrogen NPS pollution. It is mainly reflected in the facts that the extensive application of agricultural chemical inputs, low recovery rate of plastic film, random stacking and burning straw are serious. Second, Livestock producers engage in self-interested activities with negative externalities. Due to improper disposal of livestock manure, a large amount of pollutants from the livestock and poultry sector is leaching into waterbodies and soil, causing eutrophication and soil degradation[5]. Third, aquaculture producers engage in self-interested activities with negative externalities. A large amount of aquatic plant fertilizers, fish baits and excreta, chemicals, etc. are discharged disorderly, causing pollution and eutrophication in the water body.

3.2. Diffusion of agricultural NPS pollution

Natural factors such as precipitation, runoff, soil erosion, and connectivity between land and water, and their integrated effects lead to the spread of pollution. Agricultural NPS pollution is caused by rainfall moving over and through the ground. Throughout the migration and diffusion process of agricultural NPS pollution from the source area to the water body, runoff is the main driving force for soil erosion, which picks up and carries natural and anthropogenic pollutants, eventually depositing the pollutants into lakes, rivers, wetlands, coastal waters, and even ground water systems.

3.3. Institutional factors of agricultural NPS pollution

The ecological construction and pollution prevention activities with strong positive externalities often are provided directly by the government as public goods in fact. However, at present, the prevention system mechanisms of agricultural NPS pollution have some serious flaws, which causes the agricultural surface source pollution the system root. Contrary to point source pollution, NPS pollution comes from many diffuse sources, resulting in NPS pollution characterized by random occurrence, complex mechanisms, uncertain discharge channels and amounts. These characteristics lead to high cost and difficulty in monitoring and preventing NPS pollution.

4. Agricultural NPS pollution ecological compensation mechanism design

4.1. Incentive mechanism

The agricultural NPS pollution ecological compensation incentive mechanism aims to maintain the enthusiasm of policy objects (agricultural production organizations and individuals) through a series of incentive policies. It is necessary to compensate agricultural producers for their extra payment or opportunity lost due to environmental protection by subsidy policies, tax reduction policies, physical compensation, and ecological

markers, etc. Through the implementation of policies to compensate for the external benefits of pollution control activities, and gradually internalize green production behavior into self-awareness, becoming a conscious behavior. Subsidy policies and tax reduction policies refer to the compensation, subsidy, reward or reduction of taxes and fees for agricultural producers, which is based on their reduction of fertilizer application at optimal ecological and economic levels. These policies will guide agricultural producers to engage in positive externalities or reduce negative external production activities, so that rural resources and ecological environment levels reach Pareto optimality. Physical compensation refers to the government's use of physical objects that are beneficial to "green production" to compensate policy objects, such as new varieties, advanced agricultural machinery, organic fertilizers, and biodegradable agricultural films, etc. Eco-marking refers to the establishment of an independent and credible certification system to mark eco-friendly agricultural products, such as eco-food and organic food, to add value and enhance the market competitiveness of agricultural products.

4.2. Constraint mechanism

Agricultural NPS pollution ecological compensation constraint mechanism is the reverse application of incentive policy. Incentives and constraints are two aspects of one problem that should be effectively combined to maximize their effectiveness. To internalize the costs of pollution, agricultural producers may be required to pay all those harmed by pollution. The constraint mechanism regulates the behavior of policy objects by formulating, promulgating and implementing many normative requirements or rules, which consist of legal constraints, taxes and sewage charges, etc. Legal restraint refers to the obligation of law enforcement agencies to prevent pollution activities or to stipulate the duty of "polluter" to compensate or remedy in accordance with the laws enacted by the state. Taxation refers to the collection of taxes and fees on agricultural production activities that are not engaged in green production, thereby realizing the internalization of external costs of agricultural NPS pollution prevention. For example, the tax department can impose different standard taxes on different grades of agricultural inputs, reduce the taxation standards for organic fertilizers, organic pesticides, and degradable agricultural films, to stimulate agricultural producers to purchase organic agricultural inputs. The collection of sewage charges means that agricultural producer, who direct discharge of pollutants, pays the fee according to regulations and rules. For example, Taking the scale of production and the volume of pollutants as the basis for setting standards, , and the livestock farms are reasonably charged.

4.3. Technical compensation mechanism

The technical compensation mechanism refers to the promotion of new and green agricultural scientific research results and practical techniques applied to agricultural production through agricultural extension services. At present, there are some agricultural production management technologies that can effectively reduce agricultural NPS pollution, including farming management technology based on the protection of cultivated land, soil nutrient and pest management techniques based on scientific application of chemical inputs, irrigation management technology based on the avoidance of soil erosion, and livestock and poultry farming management technology based on the control of livestock and poultry pollution. Through continuous acceptance and adoption of new scientific technologies, agricultural producers continue to improve production and living environment, and ultimately achieve effective prevention and control of agricultural NPS pollution.

4.4. Intelligence compensation mechanism

The intellectual compensation mechanism refers to providing intellectual support for agricultural NPS pollution control through training, education and talent introduction. More extension work is required to educate the agricultural producers on environmental protection. On the one hand, the government should carry out the environmental protection education actively. Enhance the training on environmental protection policies and regulations, agricultural production skills, and management. On the basis of ensuring rural compulsory education, develop vocational education and adult education, to improve the cultural quality and professional skills of farmers. Through the training and education of agricultural producers, they not only master the green agricultural technology, but also instill the concept of green production, making them realize the significance of controlling agricultural NPS pollution. On the other hand, government departments should carry out intellectual services in rural areas. Provide free and convenient guidance for agricultural producers, answer relevant consultations from farmers, and transfer technical and management talents to rural areas to help improve the production skill level and organizational management level of compensated agricultural producers.

4.5. Project Compensation Mechanism

The project compensation mechanism refers to the implementation of agricultural NPS pollution control in the form of projects, with engineering governance projects and mass participation plans. The project management project will reduce agricultural NPS pollution by strengthening infrastructure construction and comprehensive environmental pollution improvement. These include that establishing rural household biogas digesters that can digest large amounts of crop straw and provide energy, building stormwater storage ponds and sedimentation ponds that can effectively reduce the cycle time of sewage, and constructing vegetation filter belts and constructed wetlands that can filter sediments, nutrients and other chemicals, etc. The mass participation plan refers to the formulation of a project plan with clear obligations and benefits, attracting agricultural producers to participate in, and signing contracts with them. During the project, the tracking, monitor and supervision of agricultural NPS pollution will be carried out. After reaching a certain period of time, the agricultural producers who meet the project plan requirements will be given a generous subsidy or reward.

References

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