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Original Research Paper

Agricultural Economy Loss in Yangtze River Basin in China Caused by Water-Environment Pollution

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ABSTRACT

This study aimed to analyse the current status of water-environment pollution in Yangtze River basin in China and to determine the size of agricultural economy loss caused by water-environment pollution based on statistical data of water-environment pollution in Yangtze River basin from 2007-2013. We initially analysed the influences of water-environment quality and agricultural nonpoint source pollution in Yangtze River basin on water environment. Then, we used the shadow price method to calculate the agricultural economy loss caused by water pollution in Yangtze River basin in 2007-2013. Finally, we proposed pertinent policies and suggestions for water-pollution governance. Results indicated the three major problems related to the study: prominent water pollution in the local area, serious pollution of agricultural nonpoint source and insufficient protective measures, and shortage of capacity for the governance of water-environment pollution in Yangtze River basin. In 2007-2013, the shadow price values of agricultural water in Yangtze River basin fluctuated within 1.46 to 1.58 (RMB/t). As a middle-level basin in China, from the aspect of time tendency, inferior V water in Yangtze River basin basically maintained a steadily decreasing tendency in recent years with little change in total water consumption. As a result, the overall degree of loss of water pollution in Yangtze River basin also presented a steadily decreasing tendency, and the annual average agricultural economy loss caused by water pollution was 17,941,000,000 (RMB). Our findings have significant realistic value in the monitoring of water-environment quality, environmental governance, and agricultural development in Yangtze River basin in China.

INTRODUCTION

Yangtze River is the third largest river in the world, and the population, water resources, and GNP (annual gross national product) within the basin comprise about 1/3 of that of the whole nation. Natural conditions within the basin are quite complicated, and at present, it faces the degradation of its resources, frequent flood and drought disasters, deteriorated ecology and environment, imbalanced economic development among its areas, and other related problems. Thus, water resource management within the basin necessitates urgent improvement. Yangtze River basin involves a total of 19 provincial-level administrative regions with a basin area measuring 1.8 million square kilometres and occupying 1/5 of the total Chinese land area. The river is an important water source for China's "four vertical and three horizontal" water resource configuration strategy, the "golden waterway" connecting west and east, a significant hydroelectric energy base, and a natural treasury house of rare aquatic animals. In addition, water resource protection in Yangtze River basin contributes to the overall situation of economic and social development. In more than 30 years of rapid economic development, insufficiency and quality deterioration of water resources in Yangtze River basin have become significant factors restricting the sustainable economic and social development in related provinces, resulting in its current grim situation.

Water-environment deterioration in Yangtze River is closely related to agricultural pollution, whereas agricultural surface pollution is the major cause of water eutrophication in lakes within the basin. Nonpoint source pollution in rural areas is caused by chemical fertilizer and pesticides, pollution by livestock and poultry industry, drainage of rural domestic sewage, and runoff pollution in mountain and forest regions, whereby the main contained pollutants like nitrogen and phosphorus, and these pollutants are the major cause of water-environment pollution in Yangtze River. However, as protection efforts concerning water resources in Yangtze River are gradually intensified, order of water use in the basin is continuously standardized, deteriorating the effective restriction of water pollution tendencies. Overall water quality of the mainstream is sound, and the improvement of water security capacity has been guaranteed. Both have provided powerful support and assurance for the smooth, steady, and rapid economic and social development, social harmony, and stability in the basin. With the rapid development of economy and society in the Yangtze River basin, discharge of sewage water is increasing year by year, pollution in local urban river segment and some branches is still serious, and eutrophication of major lakes has not been significantly improved. A certain gap between the safeness of the drinking water source and demand of the masses exist; and the governing vigour of water and soil loss and karst area is insufficient. The contradiction between shoreline development, use, and protection becomes increasingly prominent. With the new requirements, the system and mechanisms of water resource protection, the legislative system, and monitoring capacity still have a large gap to fill; and the situation of water resource protection is still severe. Water resource in Yangtze River plays a significant role in economic and social development, and the occurrences of major pollution incidents result in water source pollution and suspension of water supply in Yangtze River basin, which not only pose threats to human health but also cause enormous economic loss of agricultural development. The severe situation of the basin implores us to ponder over the loss caused by water pollution from a more accurate angle and to conduct quantitative measurement of loss caused by water pollution. Through this study, the government can gain a better understanding of the degree of pollution of water resources and employ better measures of managing and protecting water resources.

EARLIER STUDIES

The contents of research on economic loss caused by water-environment pollution and conducted by domestic and foreign scholars mainly concentrate on the two following aspects: first, based on the mechanism of pollution damage, they focused on studying the damaging effects of different pollutants on human health and organisms and proposed control measures for water-environment pollution; second, they placed particular emphasis on the angle of economics, and they established a model of economic loss caused by environmental pollution and stressed on the measurement of economic loss size caused by water-environment pollution. Segerson believed that environmental concentration expense can be used to punish the people in areas with prominent concentration levels of some pollutants and award the areas with decreasing levels of these contaminants (Segerson 1988). Young assessed the functions and values of water resource eco-compensation in the basin and analysed the optimized and reasonable allocation and protection of water resources in the basin (Young, et al. 2009). Pagiola deemed that establishing water resource eco-compensation system is necessary to make a specific analysis of the internal logic of water resource eco-compensation system in the basin (Pagiola 2008). Tang thought that charging water resource and water-environment pollution behaviours in the basin did not totally fit their ecological purpose, however, it actually generated a notable ecological effect (Tang et al. 2012). From the aspect of economic loss caused by water-environment pollution, one of the most famous theories about the relationship of economy and the environment is the "Environment Kuznets Curve," which shows an inversed U-shape curve relationship. Namely, the environmental pollution status is first presented at an aggravated state, which tends to improve with economic growth; the curve was first introduced by the American economist, Grossman. Harbaugh thought that the relationship between water pollution and GDP becomes significant through empirical study, and water pollution became more serious with the rapid economic growth (Harbaugh et al. 2002). Muyibi analysed the close relationship between social and economic development and river pollution in Malaysia, and research results indicated the existence of a causal relationship between various indexes and river pollution (Muyibi et al. 2008). Other researchers studied the curvilinear relationship between per capita discharge and per capita GDP of related factors in water-environment to ensure the continuous improvement of human health and quality of life (Tsuzuki 2009). Friedl, by studying the relationship between CO2 discharge and economic growth in Austria from 1960-1999, obtained the two presented "N" shape curvilinear relationships, however, he did not demonstrate the traditional inversed U-shape curve (Friedl et al. 2003). To sum up, domestic and foreign scholars carried out abundant studies on the status of water-environment pollution, economic loss caused by water-environment pollution, water-environment pollution control measures, etc.; however, for Yangtze River, as an important hydro-power resource, quantitative research on the economic loss attributed to its pollution status and water pollution has always been a major concern. Hence, analysing water-environment pollution status and measuring water-environment pollution can provide the Yangtze River Water Conservancy Administrative Department and Agricultural Management Department with suggestions regarding the policies for governing water pollution.

WATER-ENVIRONMENT POLLUTION STATUS IN YANGTZE RIVER BASIN

Water pollution problem in the local area is prominent, and agricultural nonpoint source pollution risk is enlarged: Water Resource Bulletin in Yangtze River Basin (2014) pointed out that in the 56 major lakes in the Yangtze River basin (Taihu water system), the water quality observed yearly is not optimal (Fig. 1). Nineteen lakes were diagnosed with medium and heavy eutrophication. Dian Lake and Chaohu Lake, of which China stressed controls were not obviously improved, were under mild or medium eutrophication. Among the 311 water sources, those with qualified annual water quality occupied 82.6% of the basin. Safety guarantee on water quality of water sources is not sufficient, and water quality-induced water shortage with varying degrees occurred in areas with advanced economy and located in the middle and lower regions of Yangtze River. In addition, at present, five major iron and steel bases and seven major oil refining centres are distributed along the river. Non-ferrous metal bases, mechanical industry bases, and petrochemical bases are also present, and the dense layout of industries with high risk of water pollution along the river bank increases the pressure on the risk prevention of major water pollution incidents, secondary water pollution, water ecological damage, and other problems caused by sudden water pollution of chemical industry parks and neglect of dangerous chemicals. In the meantime, agricultural nonpoint source pollution in Yangtze River basin presents an aggravating tendency. On the one hand, as land use and cultivation measures became unreasonable, excessive reclamation, cultivation, and deforestation, and water and soil loss within the basin turned into a serious problem. On the other hand, as population within the basin increased, especially since the 90s until the 20th century, the economy rapidly developed, accelerating urbanization progress and decreasing cultivated lands. To increase grain production, huge amounts of fertilizers and pesticides were used in farmlands, and these water body eutrophication problems caused the agricultural nonpoint source pollution.

Contradiction between the development and utilization and protection is prominent, and agricultural nonpoint source pollution, with the lack of enough protective measures, is serious: Adverse effects of unreasonable development and utilization of the ecological environment gradually manifested themselves, and pressure concerning water ecological protection and restoration increased. Some engineering constructions resulted in decreased connection of rivers and lakes, changes in aquatic habitats, and decrease in biological diversity and quantity of resources. Diversion-type hydropower station and trans-regional water drainage caused reduction in flow quantity and seasonal flow separation, and reclamation of lakes led to shrinkage of hydrophytic habitat areas and influenced the ecological safety of Yangtze River. Prevention and control of water and soil loss in river sources, important water resource districts, and ecologically vulnerable areas is arduous; controlling forces of water and soil loss in karst area and stony desertification area are insufficient; and man-made water and soil loss problem caused by production and construction is still a serious problem. Contradiction between shoreline utilization and protection became increasingly prominent, and high degree of development and utilization of local river segments and low efficiency of utilization simultaneously existed, which not only caused relative shortage but also serious waste of shoreline resources. Moreover, the layout for shoreline utilization was unreasonable, which certainly affected the safety of water supply and ecological environmental protection. The adversity of agricultural nonpoint source pollution in rural economic development in Yangtze River basin is not yet fully understood. At present, rural areas and agricultural production within the basin are more engaged in overcoming poverty, achieving prosperity, and increasing the income of the poor. After all, promoting rural economic development is the primary task of China's agricultural sector, whereas use of large quantities of pesticides and chemical fertilizers is an important approach in improving the quality of agricultural output. However, pesticides and chemical fertilizers are the major causes of nonpoint pollution. Local governments attach more importance to inviting investment to build plants and construct large engineering projects even when an obvious deficiency in the input of environmental protection in agricultural production and villages exists. For example, in Yangtze River Delta, rapid development of economic construction caused various enterprises to spring up. Blind investment invitation introduced a batch of enterprises that caused heavy pollution, and people pay the most attention to these point source pollution when speaking of environmental pollution. Still, little has been done in the pollution control practices of some township or small-scale enterprises.

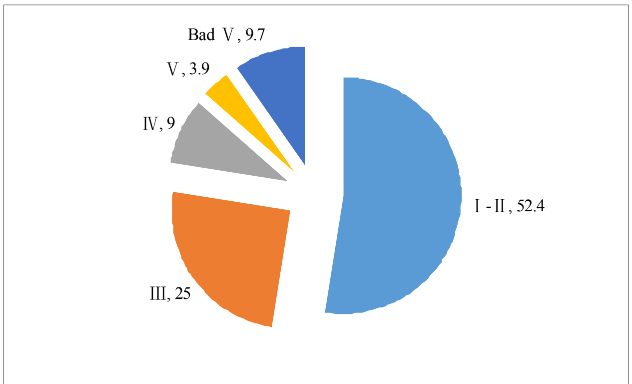

Fig. 1: 2014 Water quality status diagram of yangtze river basin (Unit: %).
(Data derived from Water Resource Bulletin in Yangtze River Basin and Southwest Rivers (2014)

Systems and mechanisms of protection are still imperfect, and governance capacity on water pollution should be improved urgently: Currently, the management system and mechanisms of water resource protection in Yangtze River are still imperfect. Institutions and regulation systems are still incomplete, and monitoring and supervising capacity is still insufficient; all of these factors still have a large gap to fill concerning the requirements for the construction of water resource protection for the Yangtze River Economic Zone. The issue on the protection of the river presents several major embodiments. The regulation system for the water resources in the basin is still imperfect, and the relevant planning system for water resource management is yet to be enhanced and improved. Trans-department and trans-regional coordination mechanisms are in the urgent process of establishment and improvement. The steadily growing input and public participation mechanisms are yet to be perfected, and the mechanisms for ecological compensation have not yet been formed. Foundation work for water functional area management remains to be intensified. Effective cohesive mechanisms covering water area assimilation capacity, total limited discharge quantity opinions, and plans for water pollution prevention are yet to be built; follow-up supervision and management awaits improvement. Monitoring and supervising capacities are still not enough to meet the water resource management and protection requirements. Construction of facilities for measuring pollution discharge outlets of river is outdated; water resource monitoring and assessing capacity and work are deficient; and water quality and quantity monitoring facilities in provincial boundaries and river control cross sections need support and improvement. In Yangtze River basin, nowadays, many young people in the rural areas are not willing to till the land, instead, they leave the rural areas to work in other places. Older people are left at home to till the land, and the situation makes the promotion of advanced science and technology difficult. At present, most people are not fully aware of environmental protection and application of chemical fertilizers and pesticides in large quantities and arbitrary abandonment of pesticide bottles are quite common. For nonpoint pollution, sewage drains for the chemical wastes are still impermanent, and accurate calculation of the discharge capacity is improbable. In addition, pollution discharge methods vary, and pollution drainage approaches are multi-channel and are even ubiquitous. Local government departments only consider the creation of agricultural income in these areas. They give little consideration to the influence of nonpoint pollution on water-environment in downstream rivers and lakes, whereas basin management organization is ineffective in controlling the sources of nonpoint pollution. Consequently, the whole process of agricultural nonpoint pollution from the source to the river lacks proper monitoring and governance.

EMPIRICAL RESEARCH ON AGRICULTURAL ECONOMY LOSS DUE TO WATER-ENVIRONMENT POLLUTION IN YANGTZE RIVER

Model and Data Specification

Model introduction: According to the calculation by Liu et al. (2014), various water shadow price values, proportion of water consumption to total water resources, and water index values of water consumptions were used, and Gaussian-Newton method was employed to build a nonlinear regression model, as shown in formula (1):

$$P_i = 1.194 + 0.249K \bullet LnX \quad ...(1)$$

Where, P_i is the shadow price (unit: RMB/m^3) of agricultural water in Yangtze River basin, K is the proportion of water consumption to the total water resources in Yangtze River basin (unit: %), and X is the average water consumption per mu of irrigation in Yangtze River basin (unit: m^3). According to this model, as long as the proportion of water consumption to total water resources and average water consumption per mu of irrigation in Yangtze River basin are given, the shadow price of agricultural water in Yangtze River can be calculated, and this calculation does not rely on the input/output table. Thus, the formula is quite simple and convenient to use.

Agricultural water consumption of inferior V water quality in Yangtze River basin was calculated, as shown by formula (2):

$$Q_i = R_i \bullet F_i \quad ...(2)$$

Where Q_i is the agricultural water consumption of inferior V water quality in the Yangtze River basin, R_i is the proportion of agricultural water consumption of inferior V water quality to total water consumption, and F_i is the total water consumption in Yangtze River basin.

Finally, the agricultural loss value caused by water pollution in Yangtze River basin was calculated, as shown by formula (3):

$$EC_i = Q_i \bullet P_i \quad ...(3)$$

Where EC_i is the agricultural loss value caused by water pollution in Yangtze River basin, and P_i and Q_i are the calculation results of (1) and (2), respectively.

Data specification: For the data needed in empirical research, three indexes-K (proportion of water consumption to total water resources in Yangtze River basin, unit is %), Q_i (agricultural water consumption of inferior V water quality in Yangtze River basin, unit is a hundred million m^3), and R_i (proportion of water consumption of inferior V water quality to total water consumption, unit is %)- were obtained from the Water Resource Bulletin in Yangtze River Basin and Southwest Rivers (2007-2013). F_i (total water consumption in Yangtze River basin, unit is a hundred million m^3) and (average water consumption per mu of actual irrigation, unit is m^3) were acquired from China Water Resources Bulletin (2007-2013).

Empirical Research

The proportion of water consumption to total water resources can directly reflect the demand and supply status of water resources. A greater proportion of water consumption to total water resources means increased scarcity of water resources in the area. On the contrary, a smaller proportion means the presence of more sufficient water resources. When the proportion of water consumption to total water resources is greater than 1, the demand exceeds the supply in the area, and conducting water diversion from other areas becomes necessary. The ratios of water consumption to total water resources in Yangtze River basin in 2007-2013 are presented in Table 1.

Shadow price is influenced by several factors, such as degree of resource scarcity and production efficiency of the economic system. Richer resources mean a lower shadow price, whereas scarcer resources mean higher shadow prices. Higher production efficiency of economic system means lower shadow price. According to formula (1), shadow price, P_i, of agricultural water in Yangtze River basin was first calculated, as given in Table 2:

Table 2 shows that the shadow price of agricultural water in Yangtze River basin fluctuated within 1.46 to 1.58 (RMB/T). This price was below the middle level when compared with those of other basins in China. Yangtze River basin covers 18 provinces (municipalities are directly under the central government), and its economic development level is relatively high. Both conditions sufficiently indicate that the production efficiency of the economic system in Yangtze River basin is relatively high.

In terms of agricultural water consumption, water quantity is abundant, plains are closely distributed, soil is fertile, drainage area is large, population is dense, and labour forces are abundant. Yangtze River basin includes areas with advanced agricultural development since the ancient times, with the most agricultural water consumption amounting to about 100 billion m^3 each year and comprising 1/4 of the total water consumption in the whole country and 1/8 of the total water resources within the basin. The proportions of agricultural water consumption of inferior V water quality in 2007-2013 in Yangtze River basin are depicted in Table 3:

Finally, according to formula (3), agricultural losses caused by water pollution from 2007-2013 in Yangtze River basin were calculated as shown in Fig 2.

Fig. 2 shows that the losses in Yangtze River basin all exceeded 18 billion RMB, and the average annual agricultural economy loss from 2007-2013 was 17,941,000,000 RMB, as agricultural development levels in Yangtze River basin became quite advanced. Thus, agricultural water consumptions were huge. At the same time, the river faced problems of water resource scarcity and water pollution, both of which led to a huge agricultural loss. From the aspect of time tendency, inferior V water in Yangtze River basin basically maintained a steadily decreasing tendency in recent years, with little change in the total water consumption. As a result, the overall degree of loss of water pollution in Yangtze River basin also presented a steadily decreasing tendency. The observations can be attributed to several major reasons. In recent years, provincial governments in Yangtze River basin gave preferential policies and introduced market mechanisms in order to reduce nonpoint source pollution caused by abuse of chemical fertilizers and to meet the requirements for scientific application of chemical fertilizers. They encouraged towns and villages to establish soil testing and fertilizer recommendation service companies, recruited farmers with professional skills, and carry out soil testing operations and fertilizer recommendations which could improve the effect of fertilizer application and reduce the amount of chemical fertilizers used. At the same time, to reduce the nonpoint source pollution caused by abuse of pesticides, they adopted door-to-door services and sprayed pesticides according to the degree and nature of farmland damage, which were convenient for intensifying the monitoring of pesticide utilization and promoting organic pesticides. They conducted centralized processing of excrements produced by livestock and poultry breeding and transformed them into organic fertilizers through the organic fertilizer production service companies in towns and villages. They

Table 1: Proportion of water consumption to total water resources in Yangtze River Basin in 2007-2013 (Unit: %).

	2007	2008	2009	2010	2011	2012	2013
Yangtze River Basin	0.22	0.21	0.23	0.18	0.26	0.19	0.23

Table 2: Shadow prices of agricultural water in Yangtze River Basin in 2007-2013 (unit: RMB/t).

	2007	2008	2009	2010	2011	2012	2013
Yangtze River Basin	1.53	1.51	1.54	1.46	1.58	1.47	1.55

Table 3: Agricultural water consumptions of inferior V water quality in 2007-2013 in Yangtze River Basin (unit is %).

	2007	2008	2009	2010	2011	2012	2013
Yangtze River Basin	14.8	14.4	14.9	13.4	12.5	12.1	11.6

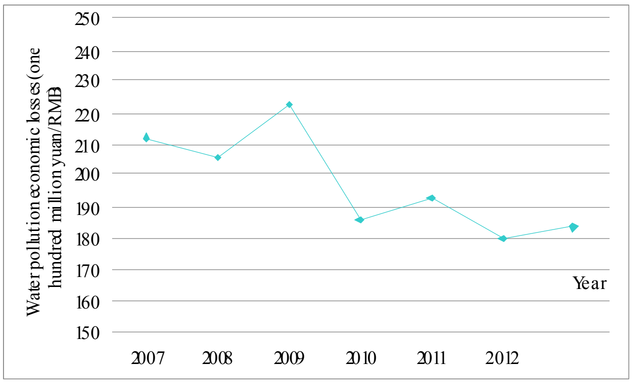

Fig. 2: Agricultural losses caused by water pollution in 2007-2013 in Yangtze River Basin.

combined agricultural production and pollution control, which made enormous contributions to the improvement of polluted water environment and reduction of agricultural economy loss in Yangtze River basin.

POLICY SUGGESTIONS

Intensity of water-pollution governance in Yangtze River basin and implementation of water ecological protection and restoration: We should vigorously promote ecological restoration of the major rivers and lakes, such as the mainstream in the middle and lower reaches, of Yangtze River, Dongting Lake, and Poyang Lake. Comprehensive governance of water ecology in important water areas, including Three Gorges Reservoir Region and Danjiangkou Reservoir, should also be implemented; comprehensive governance in heavily contaminated rivers like Minjiang River and Xiang River must carried out. We should increase water source protection and conservation force in the mainstream and branch sources of Yangtze River, implement ecological water compensation and connection projects involving rivers and lakes, and guarantee the water supply of ecological environments in river source areas, major rivers, and lakes. We should reinforce protection of important wet lands, restore the lake from the land and wet the lands on the farmland, strictly forbid lake reclamation and occupation, and set a time limit for restoring the encroached water source conservation space. We should explore and establish a health assessment system for the rivers and lakes in the basin, study and build an evaluation index system for river basin ecological water utilization and river ecology, and then carry out a health survey and assessment of important rivers, lakes, and wet lands in the basin. We should conduct ecological water compensation and connection projects about rivers and lakes, guarantee water supply of ecological environments in river source areas, main plateau lakes, and wet lands, such as Chao Lake, Ganfu water system, and so on. We should reinforce ecological flow management status survey of main control of the cross sections of the basin, further deepen the study and put forward ecological flow guarantee requirements, intensify supervision and regulation force, implement ecological scheduling, guarantee ecological flow and water level in the main control cross sections of Yangtze River main streams and branches, actively promote implementation of pilot of water eco-civilized cities, and experience the promotion of a pilot project construction.

Intensity of comprehensive monitoring and control of water resource protection, and elevation of water-pollution governance capacity: We should hasten the promotion of a comprehensive monitoring management of important control cross sections, water functional areas, water inlets and outlets, drinking water sources, important wet lands, shorelines and water areas, underground water and sudden water incidents in provincial boundaries, water system nodes, water diversion project, and so on. Moreover, we should enhance real-time monitoring and improve the pertinence and timeliness of supervisory touring measurement. We should promote the monitoring of aquatic organisms, enhance daily monitoring work and intensity centralized-type surface water and drinking water source monitoring and emergency monitoring, perfect the water resource protection and monitoring station net and functions, propel resource information integration, use remote sensing, telemetering, internet, and cloud technology to intensify the dynamic monitoring of water resource protection, reinforce the net construction of comprehensive monitoring station for water resource protection, establish deep integration of information technology and business management as well as the modernization of the comprehensive management information platform for information sharing, pay attention to the promotion of a more comprehensive monitoring level of supervisory monitoring, touring measurement, sudden water incidents, river and lake shorelines, nonpoint source pollution and so on, and intensify the monitoring and controlling facilities and construct a talented team for water resource protection.

Establishment and perfection of an agricultural water-environment pollution monitoring system and intensification of publicity and education on agricultural environmental protection: Agricultural nonpoint source pollution monitoring system in Yangtze River basin is not perfect enough due to its weak technical strength, shortage of monitoring means, and inability to adopt the requirements for an agriculturally sustainable development. Actively striving for emphasis and support from related government departments at all levels is necessary. Increasing the input, enriching teams, equipping the people involved with the necessary modern instruments and equipments, establishing a high-quality agricultural nonpoint source monitoring team, carrying out the monitoring of agricultural nonpoint source pollution, researching, developing, promoting biological prevention and control technology, utilizing and improving the pesticide application method, improving pesticide utilization efficiency, and reducing the amount of pesticide use are important as well. We should improve soil structure and maintenance of soil fertilizer and supply capacity. We should further reduce fertilizer loss, improve nitrogen, phosphorus, and potassium balance, and vigorously promote a balanced fertilization technology. In rural livestock and poultry-raising households, with their large-scale farms, villages, and towns, we should vigorously promote the harmlessness of the excrements of livestock and poultry, and their potential in becoming a resourceful treatment technology and sewage disposal technology. We should intensify publicity of agricultural environmental protection and popularization of science for the public welfare, and improve awareness of environmental protection of the general public. We must spare no efforts to persist in adopting all kinds of means and forms to popularize knowledge on agricultural environmental protection, and thus, improve awareness of agro-ecological environment of the whole society and make governmental departments at all levels and the masses recognize the importance of the reasonable development and utilization of agricultural resources and protection of agro-ecological environment.

CONCLUSION

To make a quantitative analysis of the status of water-environment pollution in Yangtze River and to measure the agricultural economy loss caused by water-environment pollution, shadow price method was used to calculate the agricultural economy losses caused by water pollution in Yangtze River basin in China in 2007-2013. Finally, this paper proposes several policy suggestions from various aspects. Research of this paper discovered that the three major problems-prominent water pollution in local areas, seriousness of agricultural nonpoint pollution with the lack of enough protective measures, and deficiency of governance capacity over water environments in Yangtze River basin from 2007-2013. The shadow prices of the agricultural water in Yangtze River basin fluctuated within the range of 1.46-1.58 (RMB/t), which was under the middle level of various basins. From the aspect of time tendency, inferior V water in Yangtze River basin basically maintained a steadily decreasing tendency in recent years with little change in the total water consumption. As a result, the overall degree of loss of water pollution in Yangtze River basin also presented a steadily decreasing tendency, and the annual average agricultural economy loss caused by water pollution was 17,941,000,000 (RMB). This paper presents good reference values for the full understanding of water-environment quality and puts forward specific measures of improving water-environment quality in Yangtze River basin. However, Yangtze River basin is a vast territory, and its economic development level, economic structure, agricultural structure, and natural conditions in different regions are also different. The degree of influence of water pollution on the said factors and the influences caused by water pollution are also quite different, thus, future research can build a panel data of the 19 provinces (municipalities are directly under the central government) in Yangtze River basin and further analyse the agricultural loss caused by water-environment pollution under different economic conditions as well as natural environments and technical features in different regions in order to take specific measures in governing water pollution (for example, northern areas are short of water resources. Consequently, large quantities of sewage irrigation appear. These areas should develop a method of sewage treatment, drop irrigation and spray irrigation technologies, or relieve water shortage status through external water transfer. Southern areas are seriously in shortage of water due to pollution, thus, they should conduct pollution control and develop an environmentally friendly agriculture).

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