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Environment Pollution State and Improvement Measures in Rural Areas of Heilongjiang, China

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ABSTRACT

With the development of social economy and industrialization, environment pollution in rural areas is increasingly serious and the rural ecological environment is destroyed continuously, which have become constraints against the sound and sustainable development of rural economy in China. Existing studies on rural environment pollution state were reviewed to further analyse the rural environment pollution state and then to introduce corresponding suggestions. The rural environment pollution state in Heilongjiang Province was analysed. In the past decade, industrial waste gas and industrial solid waste outputs of township enterprises have increased by 3.81% and 18.72% respectively. Random livestock excrement disposal, low straw utilization, and continuous growth of household garbage throughput are important manifestations of rural environment pollution. Poor environment protection consciousness of peasant, poor monitoring of rural environment pollution and imperfect management systems are the most prominent problems in rural environment pollution control. Finally, specific measures to control rural environment pollution were proposed, including increasing attention to environment protection, forming effective environment protection mechanism, increasing financial input to environment protection, and strengthening legal monitoring. Conclusions obtained in the study can provide significant references to explore further countermeasures to rural environment pollution that conform to actual situations in Heilongjiang of China.

INTRODUCTION

Rural area accounts for nearly 95% of China's territory. Rural development has great regional gaps. Rural ecological environment is suffering from increasing stresses and intensifying rural environment pollution due to abuse of pesticide, chemical fertilizer, and agricultural plastic films in agricultural production activities; accumulation of domestic wastes that surrounding the rural areas; non-standard development of livestock breeding in rural areas; and domestic waste transfer from urban areas. Rural economic growth is accompanied with environment damages, manifested by air, soil, and water pollution; reduction of crop yields; and deteriorating quality of agricultural products. All of these pollution sources not only threaten human safety, but also restrict industrial development in rural areas, thereby disturbing modern ecological agricultural development.

Serious environment pollution in rural areas of Heilongjiang Province is caused by rapid economic growth. The value of agriculture increased in the past decade (Fig. 1). Continuous environment deterioration occurs with the rapid economic development in rural areas. Environment management costs caused by coarse development and economic model are often higher than economic output. Rural economic development is often accompanied with high resource consumption and low output, which indicate the significantly poor resource refining. In rural areas, underdeveloped principal industries and large consumption of chemical products (e.g., pesticide and chemical fertilizer) are observed. However, rural environment protection infrastructure in Heilongjiang is weak, and rural environment protection starts late.

STATE OF THE ART

According to recent practices in China and abroad, environmental pollution has become an important constraint of rural development. If no solution is provided for environment pollution, social development is hard to maintain in rural areas. More scholars have shifted their attention from urban environment to rural environment and have made many studies on rural environment pollution status and governance measures. With respect to rural environment pollution status, Bramley mainly studied environment status in European rural areas and summarized major environment problems in European rural areas (Bramley 1997). Diamantini et al. found that universal use of chemical industrial products in agricultural production has destroyed

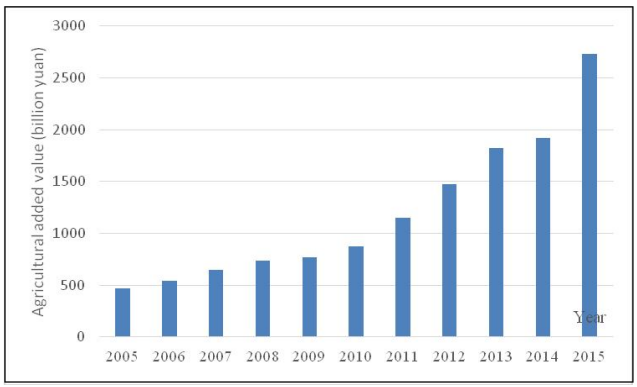

Fig. 1: Added value of agriculture in Heilongjiang from 2005 to 2015 (Data source: Statistical Yearbook of Heilongjiang, 2016).

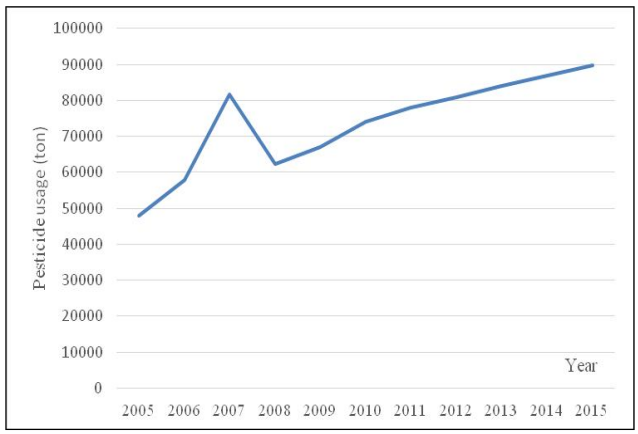

Fig. 2: Consumption of pesticide in Heilongjiang from 2005 to 2015.

rural ecological environment and changed physicochemical properties of soil. Moreover, use of chemical industrial products has caused bad impact on local subsequent agricultural development (Diamantini et al. 2000). Swanson et al. analysed the environment pollution status in Zhejiang Province (China) and causes (Swanson et al. 2007). Sun et al. analysed the current situations and development strategies of agricultural residual resources in China (Sun et al. 2005). Garland et al. analysed the impact of airborne particulates on air pollution, radiation capacity, and long range in rural environments surrounding megalopolis (Guangzhou) in China (Garland et al. 2008). Kulshrestha et al. studied PM2.5 and PM10 concentrations and seasonal changes in Agra city in India and surrounding rural environments and found that human activities and industrial emission are major sources of air pollution in rural areas (Kulshrestha et al. 2009). Chen et al. discussed the air pollution in rural areas in North China Plain and believed that traffic is the major cause of rural air pollution (Chen et al. 2017). Muyanja et al. studied the air pollution in rural household in Uganda caused by kerosene lighting (Muyanja et al. 2017). With respect to rural environment pollution control, Brown et al. improved the soil quality by forbidding the use of pesticide and chemical fertilizers, advocating farmyard manure and green manure, scientific reasonable intercropping and crop rotation system or appropriate straw turnover (Brown et al. 1997). Novotny believed that rural environment pollution can be controlled by strengthening household management on the consumption of fertilizers and pesticides and garbage disposal in rural areas (Novotny 1999). Randall et al. deemed that agricultural non-point source pollution from households to agricultural production can be reduced by giving households technological and financial support and encouraging them to adopt environment friendly technologies (Randall et al. 2000). Godby believed that the government should manage rural environment pollution by setting up the emission trading institution and government regulation mechanism (Godby 2002). Ayres pointed out that soil quality in rural areas can be protected by designing diversified ecosystems, by using characteristics of agricultural crops and adaptability of local seeds, as well as geomorphology and internal and external soil conditions (Ayres 2004). Collins et al. analysed how to relieve impacts of agricultural pollution dispersion on the whole of Europe and Britain (Collins et al. 2016). Zhang et al. discussed the emission characteristics of agricultural crop residues in China and its environment influences and control measures (Zhang et al. 2017). Based on the above literature review, studies on rural environment management mainly focuses on rural environment pollution control mechanism and control measures. However, rural environment pollution has led to more complicated situations and characteristics than urban environment pollution. Heilongjiang is a big agricultural province in China. Studying rural environment pollution state in Heilongjiang Province and putting forward corresponding suggestions can provide theoretical reference to local competent departments.

RURAL ENVIRONMENT STATE IN HEILONGJIANG PROVINCE

Serious environment pollution caused by agricultural production: As a big agricultural province in China, Heilongjiang is an important production base of commodity grains. With the annual growth of agricultural output value, consumption of modern agricultural chemical products like fertilizer and pesticide increased every year. Although Heilongjiang Province has been promoting green foods and organic foods in recent years and the annual growth of consumption of agricultural chemical products was relieved to some extent, the consumption still kept increasing. Extensive abuse of modern agricultural chemical

Table 1: Consumption of chemical fertilizers from 2010 to 2014.

Year	2010	2011	2012	2013	2014
Consumption of chemical fertilizer (10,000 tons)	214.9	228.4	240.3	245	251.9
N fertilizer	77.4	81.9	86	86.8	89
P fertilizer	47.4	49.1	51.1	50.9	52.4
K fertilizer	30.8	34.1	35.7	37	37.9
Compound fertilizer	59.4	63.3	67.5	70.4	72.7

(Data source: Statistical Yearbook of Heilongjiang (2011-2015))

Table 2: Industrial pollution emission from 2012 to 2015.

Year	2012	2013	2014	2015
Item				
Industrial wastewater (10,000 tons)	58,350	47,796	41,984	36,410
Industrial waste gas (100,000,000m^3)	10,445	10,622	12,091	10,843
Industrial solid waste output (10,000 tons)	6,313	6,094	6,312	7,495

products in agricultural production is an important cause of rural environment pollution in Heilongjiang Province. Although fertilizer use can increase grain yield, some peasants depend on fertilizer, thereby increasing the annual growth of fertilizer use, deteriorating soil quality, and weakening the basic fertility of soils.

In Table 1, chemical fertilizer consumption in Heilongjiang Province reached 2,519,000 tons in 2014, which was nearly 500,000 tons higher than that in 2010. Consumptions of N, P, K, and compound fertilizers were 15%, 11%, 23% and 22%, respectively, higher than those in 2010. However, the average utilization of chemical fertilizer was relatively low (only about 40%), which was nearly 10% lower than that in European and American developed countries. Chemical fertilizer residuals became an important rural environment pollution source.

In addition, although pesticide is effective in killing crop insects and can increase crop yield significantly, extensive abuse of pesticide is another important rural environment pollution source in Heilongjiang Province. In Fig. 2, consumption of pesticide in Heilongjiang Province was 48,000 tons in 2005; however, consumption increased by 87% in 2015. Due to annual consumption growth of pesticide, excessive pesticides enter into the water systems with surface runoff, which causes water pollution in local rural areas and great pesticide residues on crops. These pesticide residues will enter livestock and human bodies through the food chain, thereby posing a threat to physical health of urban and rural residents.

In agricultural production, plastic film can accelerate maturation of crops and increase quality and productivity of crops. However, plastic films are a kind of macromolecular organic chemical polymer. Most of these films are from disposal goods and do not degrade under natural conditions. Moreover, plastic film can remain in soils for over 200 years. Residual plastic films scatter everywhere in farmlands, front and back of houses, and field edges that cause serious white pollution and destroy rural ecological environment seriously. In Fig. 3, the plastic film consumption in Heilongjiang Province was 23,000 tons in 2005, but increased every year and reached 1.51 times the initial amount in 2014. Therefore, plastic film residue has become one of important rural environment pollution source in Heilongjiang Province.

Continuous growth of industrial pollution caused by township enterprises: Township enterprises in Heilongjiang Province are emerging quickly and have led to the transfer of surplus rural labour force, increase of agricultural production input, and acceleration of rural industrial development. However, rural environment pollution has intensified, which is attributed to backward technologies, old equipment, high energy consumption, and low resource utilization, and economic benefits are over emphasized while environment protection is neglected. Total industrial pollution in Heilongjiang Province reflects the industrial pollution caused indirectly by township enterprises (Table 2). Township enterprises have small-scale and scattered distribution characteristics. Most township enterprises are in rural surrounding regions and close to rivers. With the rapid development of township enterprises in recent years, most urban industrial enterprises have moved to towns and counties gradually, which will increase proportion of industrial pollutant emissions in rural areas. Furthermore, township enterprises will discharge pollutants to rural environment randomly to reduce production cost that causes

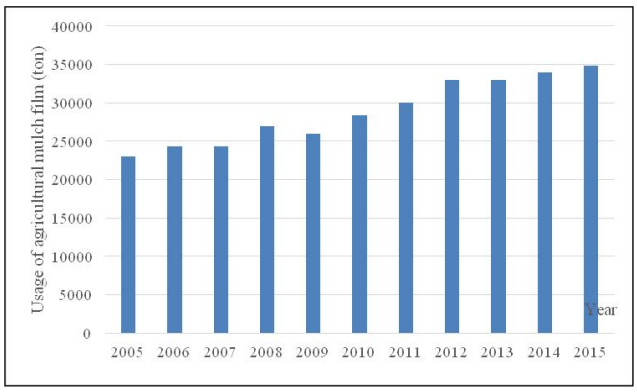

Fig. 3: Consumption of agricultural plastic film in Heilongjiang from 2005 to 2015.

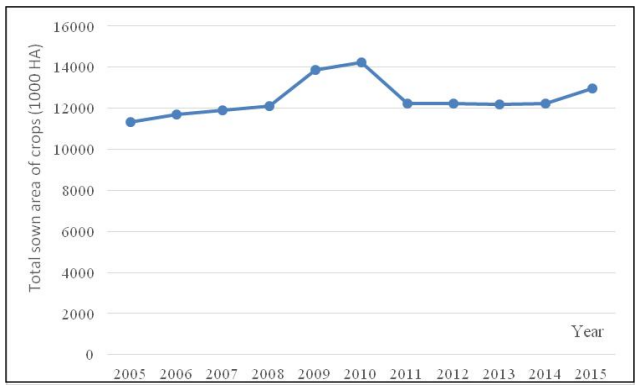

Fig. 4: Total crop planting areas in Heilongjiang from 2005 to 2015.

water source pollution and destroys rural ecological environment significantly.

In Table 2, industrial wastewater, industrial waste gas, and industrial solid waste outputs in 2012 were 583.50 million of tons, 1,044.5 billion of m^3, and 63.13 million of tons, respectively. In 2015, industrial wastewater emission decreased to some extent, but industrial waste gas and industrial solid waste output increased by 3.81% and 18.72%, respectively.

Accelerating environment pollution caused by livestock excrement emission and low straw utilization: With the rapid development of livestock industry in China, livestock breeding in Heilongjiang was developing, and the scale was expanding continuously. Livestock industry has become an important source of economic aggregate in Heilongjiang Province. Due to universal and concentrated livestock industry, great quantity of livestock excrement emission in centralized distribution is observed. In addition, given that large-scale modern livestock farms and small household livestock breeding in Heilongjiang Province have been on a low-scale level, pollutants from livestock breeding are discharged directly without proper processing and utilization, which caused pollution to local water resources, air, and living environment and accelerated the propagation of livestock diseases. These problems restrict green development of livestock industry in Heilongjiang Province to a large extent.

Planting areas of crops increased from 11,322 HA in 2005 to 12,965 HA in 2015, which shows a growth of about 12.67%. Corn, rice, and bean are major crops in Heilongjiang Province; these crops are important sources of straw. At present, straw utilization in Heilongjiang is at the beginning stage, and crop straws are underused. Crop straws become wastes, which scatter and are combusted randomly. In addition, combustion of crop straws will generate abundant nitric oxide, CO_2, and other harmful gases, which form acid rain, intensify rural environment pollution, and threaten human health.

Rural environment pollution caused by household garbage: Rural domestic pollution is mainly caused by domestic garbage and domestic wastewater. At present, rural wastewater in Heilongjiang is processed at a low rate. Given the limited economic conditions in rural areas in Heilongjiang, drainage channels and domestic sewage processing facilities are unavailable in most villages, and domestic wastewater is discharged to rural environment directly without any treatment. An estimated 80% of domestic wastewater in Heilongjiang will be contributed by villages in the future that influences residential environment of rural areas and threatens health of rural residents significantly. Without special garbage collection, transportation, and centralized landfill facilities in most villages in Heilongjiang, domestic garbage piles up in open areas (e.g., in and out of villages, road sides, and front and back of houses), which become an important source for rural environment pollution. If rural domestic garbage piles up for a long time, amide, sulfide, and other harmful gases will be generated. This finding will not only influence physical health of rural residents, but also cause air pollution. Leachate from garbage corrosion will pollute surrounding surface water, underground water, and soils. Such pollution subsequently deteriorates the rural environment.

MANAGEMENT PROBLEMS

Poor environment protection consciousness of peasant households: Rural areas in Heilongjiang Province are distant and rural residents scatter around. During the rural economic development, peasant household pay little attention to the rural environment. Moreover, rural residents in Heilongjiang Province still have many bad production and living habits in many polluted environments. Poor under-

standing of rural residents to rural environment pollution further intensifies rural environment pollution. Although peasant households are important subjects of rural environment pollution management, they fail to become the main force of rural environment pollution management because of their poor consciousness of environment protection.

Poor monitoring on rural environment pollution: Heilongjiang is an important production base of commodity grains in China. Rural environment quality monitoring is an important guarantee to green agricultural products and human health. However, the environment monitoring system in Heilongjiang is mainly established for urban environment pollution and industrial pollution sources and has poor monitoring capacity on rural environment quality. Although rural environment quality monitoring in Heilongjiang Province has been carried out for years, agreement on sampling method and monitoring indexes of water and soil in rural areas have not been reached. The evaluation standard is only limited to the classification evaluation of water, gas, and soil. Particularly, available monitoring indexes on modern agricultural chemical products, such as chemical fertilizer and pesticide, are imperfect and do not adequately reflect rural environment quality. The lack of rural environment protection mechanism and crossing management functions calls for an established monitoring system that can solve rural environment pollution problems.

Imperfect management system: Currently, a rural environment pollution control system according to rural characteristics, especially specific pollution control systems (e.g., rural drinking water source protection, rural livestock breeding pollution, rural domestic pollution, and rural environment infrastructure construction), has not been established in Heilongjiang. Existing environment management policies cannot provide theoretical support to specific rural environment pollution control. These policies cause imperfect rural environment pollution control system to a certain extent and go against effective solution of rural environment pollution problems.

SUGGESTIONS

Increasing attention and consciousness to environment protection: Rural environment protection is a comprehensive work and involves multiple departments and links. Government leadership needs to be strengthened, planning should be unified, and joint development of industries should be realized. All levels of government need to set up standing bodies for monitoring rural environment pollution governance based on previous environment protection, formulate plans, annual goal, working range, and assessment mechanism of environment protection, and thereby set long-term environment protection mechanism and promote it by stages. Meanwhile, local governments shall disclose environment protection governance conditions to the society through multiple ways, which include the following: organizing technological promotion and exchange, strengthening environment protection promotion, and monitoring township enterprises with serious pollution, attaching key attention to enterprises that discharge wastewater, and shutting down enterprises with unqualified pollution processing equipment to ensure environment protection. Moreover, environment protection shall be used as the performance goal of the government. A long-term accountability system to leaders at all levels shall be constructed. Consumption of chemical fertilizer, pesticide, and plastic film and increase in the utilization of pesticide and chemical fertilizer should be controlled strictly. Plastic films should also be recovered. Government shall stipulate consumption standards of chemical fertilizer, pesticide, and plastic film in accordance to the local agricultural production conditions and execute them strictly. Subsequently, the government shall adopt the principle that whoever causes pollution is held responsible for treatment; they should reduce residual pollution gradually and control pollutant emission of enterprises within reasonable levels.

Strengthening coordination of departments and forming an effective environment protection system: Cooperation of multiple departments has to be emphasized to provide adequate resources and staff. Management of financial sector shall be improved. Corresponding expenditure shall be enlisted into government operations; this measure increases investment and protects the environment. Legal departments shall be integrated for assistance and announced within the legal extent of competence. A systematic legal system involving multiple departments shall be established. Connections of competent departments, including environment protection, environment sanitation, civil administration, and financial department, shall be enhanced. The rural industrial development and overall environment governance effects are facilitated and improved through systematic work. In grassroots, especially in rural areas with serious environment pollution, these suggestions shall be integrate rural residents, increase consciousness of environment protection, implement environment protection behaviour, enhance construction of rural environment pollution control facilities, and form environment protection cooperation. Attention shall be paid in coordinating departments to solve further rural environment pollution problems and avoid multiple claims of financial costs. Environment protection responsibility shall be endowed to organizations and individuals. At the same time, a special evaluation system of environment protection performance

shall be established to track environment protection performance and punish illegal behaviour.

Increasing capital input for environment protection and managing environment pollution based on technology: A financial supporting mechanism must be established for rural environment protection. Rural environment protection shall be enhanced to change rural appearance. Livestock industrial management shall be enhanced and environment protection of large livestock farm shall be improved. Government can set up special ecological demonstration engineering to promote ecological philosophy by actual activities. Meanwhile, garbage recycling facilities, sewage discharge facilities, and solid-waste disposal facilities can be constructed by integrating corresponding facilities with special funding support. Investment to environment protection shall be increased for the sake of scientific use of provisions and construction of a group of environment protection projects conforming to national regulations. The government shall attract private investors to establish further and perfect special environment protection funds and capital support to pollutant treatment enterprises; this measure will not only develop the government's leading role in environment protection but also brings enterprises into the environment protection and environment governance that holds enterprises responsible for pollution management. Based on the increasing capital input to environment protection, innovative technological reform and intelligence of environment protection should be deepened continuously.

Reinforcing legal monitoring and implementing related laws and regulations comprehensively: Laws, regulations, and environment protection monitoring system have to be established and perfected and environment protection laws must be strongly enforce to protect benign development of environment protection and environment pollution control. The government should increase environment consciousness of local enterprises by strengthening the construction of new laws and help all social classes be aware of environment protection importance in several ways, such as supporting propaganda, enhance training for enterprises on environment protection consciousness, take a strong stand against illegal problems through various special activities, enhance environment pollution prevention, and avoid pollution damages. Enterprises with large pollution emission must continuously make follow-up survey on pollution emissions. The government need to enhance supervision and law enforcement, force enterprises to explore improvement and construction of a perfect pollutant emission system, restrict development of heavy pollution enterprises, highlight the accountability system of enterprises, and implement thoroughly environment protection in the local government, competent environment protection departments, enterprises, and individuals. All these proposals can solve environment pollution problems fundamentally.

CONCLUSIONS

Heilongjiang, which is a large agricultural province, possesses a big population, weak agricultural basis, and low rural income. Economic development and social welfare development are accompanied with rural environment pollution, which influences production and living quality of rural residents. In this study, existing studies on rural environment pollution state and management are reviewed. Rural environment pollution state and corresponding management problems in Heilongjiang are analysed. Over dependence on chemical fertilizer, serious pesticide abuse, and residual plastic film are causes of serious rural environment pollution in China. Random disposal of industrial waste gas and solid wastes by township enterprises, random livestock excrement disposal, low straw utilization, and continuous growth of household garbage throughput intensify rural environment pollution. Poor environment protection consciousness of peasant household, poor monitoring on rural environment pollution, and imperfect management systems are the most prominent problems in rural environment pollution control. Finally, specific measures to control rural environment pollution are proposed. Future intensive studies on non-point agricultural pollution, livestock breeding pollution, rural domestic pollution, and industrial wastes are recommended.

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REFERENCES

Ayres, R.U. 2004. On the life cycle metaphor: where ecology and economics diverge. Ecological Economics, 48(4): 425-438.

Bramley, M. 1997. Future issues in environment protection: A European perspective. Water and Environment Journal, 11(2): 79-86.

Brown, M.T. and Ulgiati, S. 1997. Emergy-based indices and ratios to evaluate sustainability: Monitoring economies and technology

toward environmently sound innovation. Ecological Engineering, 9(1): 51-69.

Chen, D., Liu, X. and Lang, J. et al. 2017. Estimating the contribution of regional transport to PM 2.5 air pollution in a rural area on the North China Plain. Science of the Total Environment, 583(4): 280-291.

Collins, A.L., Zhang, Y.S. and Winter, M. et al. 2016. Tackling agricultural diffuse pollution: What might uptake of farmer-preferred measures deliver for emissions to water and air? Science of the Total Environment, 547(22): 269-281.

Diamantini, C. and Zanon, B. 2000. Planning the urban sustainable development: The case of the plan for the province of Trento, Italy. Environment Impact Assessment Review, 20(3): 299-310.

Garland, R.M., Yang, H. and Schmid, O. et al. 2008. Aerosol optical properties in a rural environment near the mega-city Guangzhou, China: Implications for regional air pollution, radiative forcing and remote sensing. Atmospheric Chemistry and Physics, 8(17): 5161-5186.

Godby, R. 2002. Market power in laboratory emission permit markets. Environment and Resource Economics, 23(3): 279-318.

Kulshrestha, A., Satsangi, P.G. and Masih, J. et al. 2009. Metal concentration of PM 2.5 and PM 10 particles and seasonal variations in urban and rural environment of Agra, India. Science of the Total Environment, 407(24): 6196-6204.

Muyanja, D., Allen, J. G. and Vallarino, J. et al. 2017. Kerosene lighting contributes to household air pollution in rural Uganda. Indoor Air, 27(5): 1022-1029.

Novotny, V. 1999. Integrating diffuseinonpoint pollution control and water body restoration into watershed management. Journal of the American Water Resources Association, 35(4): 717-727.

Randall, A. and Taylor, M.A. 2000. Incentive-based solutions to agricultural environment problems: recent developments in theory and practice. Journal of Agricultural and Applied Economics, 32(2): 221-234.

Sun, Y., Li, G. and Zhang, F.D. et al. 2005. Status quo and developmental strategy of agricultural residues resources in China. Transactions of the Chinese Society of Agricultural Engineering, 21(8): 169-173.

Swanson, K.E., Kuhn, R.G. and Xu, W. 2001. Environment policy implementation in rural China: A case study of Yuhang, Zhejiang. Environment Management, 27(4): 481-491.

Zhang, H., Hu, J. and Qi, Y. et al. 2017. Emission characterization, environment impact, and control measure of PM 2.5 emitted from agricultural crop residue burning in China. Journal of Cleaner Production, 149(4): 629-635.