



Study on the Hazards of Livestock and Poultry Breeding Pollution and the Legal Measures for Ecological Control: A Case Study of Guangdong Province in China

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ABSTRACT

The current models of traditional livestock and poultry breeding emphasize the expansion of the development scale and increasing the economic benefits of stockbreeding, which have caused severe environmental pollution and waste of resources. Moreover, few laws and regulations have been developed to control livestock and poultry breeding pollution. Different places have set up different standards for pollution and the ecological control rules are not feasible. These facts further increase the hazards of livestock and poultry breeding pollution. In order to further analyse the pollution hazards caused by the livestock and poultry breeding, this study summarizes the categories of pollution hazards caused by the livestock and poultry breeding, and explores the causes for these hazards, with Guangdong Province in China as an example. It further proposes legal measures for ecological control of livestock and poultry breeding pollution. Results show that livestock and poultry breeding pollution can be reflected from three aspects, namely, soil pollution, water pollution and air pollution, and that unreasonable traditional livestock and poultry breeding layout, extensive breeding mode, backward disposal of breeding waste, and weak prevention and control of livestock and poultry breeding pollution are four major causes for such kind of pollution. The ecological control of livestock and poultry breeding pollution hazards can be achieved by implementing specific legal measures, such as: improving the legislation for controlling livestock and poultry breeding pollution in rural areas; establishing a rural environment enforcement agency of uniform power, authority and responsibility; strengthening the supervision mechanism for rural environmental law enforcement; improving the damage compensation system for rural environmental pollution; enhancing the legal construction of agricultural industry organizations. These findings are of great practical significance to the adjustment and optimization of livestock and poultry breeding layouts, the promotion and application of ecological livestock and poultry breeding models, the harmless treatments of livestock and poultry excrements, the improvement of the rural environment and the promotion of sustainable development of animal husbandry.

INTRODUCTION

Among the numerous pollutions from agricultural sources, that from livestock and poultry breeding is increasing in prominence, because most of the livestock and poultry farms have not been equipped with pollution control facilities. Once the highly concentrated livestock and poultry breeding wastewater is discharged into the nearby water bodies, the quality of water will deteriorate and the bodies of water will suffer serious eutrophication because of the high contents of nitrogen and phosphorus in the wastewater, thereby causing the death of some aquatic organisms. Therefore, the body of water will become paralysed and fail to perform its roles. Moreover, when toxic and harmful components in the livestock and poultry breeding pollutants penetrate the groundwater system, the content of dissolved oxygen in the groundwater will decrease. The continuous accumulation of toxic and harmful components in the bodies of water will

cause continuous pollution that causes groundwater system malfunction.

Livestock and poultry breeding is an important industry for rural economic development in the Guangdong Province, with the scale of livestock and poultry breeding increasing annually. Thus, the total number of livestock and poultry farms continues to increase, as shown in Fig. 1. The vigorous development of livestock and poultry breeding drives the development of relevant industries, such as fodder, veterinary medicine, processing, refrigeration and transportation, and also helps transfer several rural labour forces. However, this rapid development is mainly based on traditional livestock and poultry breeding. In terms of development direction, they simply expand their own farming scales and increase the number of animals raised. In terms of development goals, they just focus on improving their own short-term economic benefits, but seriously violate the idea

of a comprehensive and coordinated development of various industries in rural areas. Meanwhile, the explosive growth of population, the improvement of people's living standards, the increasing demand for livestock products, and the progress of livestock and poultry breeding techniques and feed technology lead to the transformation of the business mode of livestock and poultry breeding. The animal excrements and feeding waste from the livestock and poultry breeding industry are arbitrarily discharged into the water, atmosphere and soil because of the long-term presence of unreasonable factors in the traditional breeding mode. As a result, surrounding ecological environmental pollution occurs and infectious pathogens, such as viruses and bacteria, become dominant. Thus, the residents' daily life and the public health security are seriously affected and huge economic losses are caused because of ecological environment damage. Therefore, legal measures have been proposed for ecological control, and the shortcomings of the existing system have been cited by analysing the hazards of livestock and poultry breeding pollution. This study provides suggestions for improving the existing legal system of prevention and control of livestock and poultry breeding industry. This work is also of great practical significance to the adjustment and optimization of livestock and poultry breeding layout, the construction of ecological animal husbandry villages, the promotion of ecological livestock and poultry breeding model, and the harmless treatment of livestock and poultry excrements.

EARLIER STUDIES

Several works, such as actively implementing ecological protection and pollution control measures, have been performed to develop the livestock and poultry breeding industries in foreign countries. They have accumulated greatly advanced experience for controlling livestock and poultry breeding pollution hazards. In terms of environmental pollution caused by livestock and poultry breeding, Tamminga analysed the number of livestock and poultry breeding and the areas of surrounding farmlands in different European regions, and investigated the secondary pollution caused by livestock and poultry excreta on the surrounding environments (Tamminga 2003). Fujino considered that agricultural pollution to be generally caused by people's collective agricultural activities (Fujino et al. 2005). Sun evaluated the pollution from livestock and poultry breeding in China (Sun et al. 2013). Smit dissected the air pollution caused by the livestock and poultry breeding (Smit et al. 2014). Long explored the pollution load from the livestock and poultry production in Xiangtan of Hunan Province in the past 10 years (Long et al. 2014). Li analysed the potential role of livestock and poultry waste in China's rural biogas

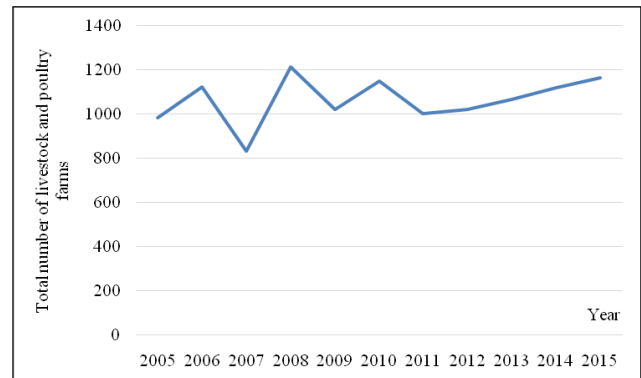


Fig. 1: Total number of livestock and poultry farms.

energy (Li et al. 2016). In terms of the control measures for the pollution of livestock and poultry breeding, Romstad considered that an agricultural pollution control and monitoring mechanism should be established to encourage the farmers to take the initiative to report the pollution and reduce emissions through self-discipline (Romstad 2003). Liang studied the environmental pollution caused by livestock and poultry in Jiangsu Province and proposed relevant measures and policies to reduce the pollution (Liang et al. 2013). Wu analysed the current status of livestock waste pollution and offered counter measures for reducing the livestock and poultry breeding pollution (Wu et al. 2014). Jie dissected the regional differences in livestock and poultry production and provided counter measures of intensive livestock farming (Jie et al. 2015). Hong proposed prevention and control measures for agricultural nonpoint source pollution in the Taihu Lake basin (Hong 2015). Yong concluded that the environmental pollution caused by large-scale livestock and poultry breeding can be prevented and controlled through legislation. Jing explored the interplay between enterprises and farmers in controlling environmental pollution caused by pigs and proposed measures for controlling the livestock and poultry breeding pollution (Jing et al. 2016). Pan adopted an experimental method to analyse the advantages and disadvantages of China's livestock pollution control policies (Pan et al. 2016). According to these studies, foreign countries prefer to conduct control and management of pollution of livestock and poultry breeding through specific technical measures. Moreover, they have developed technical standards for the environment management of livestock and poultry breeding. Furthermore, the environment of the livestock and poultry farms must be managed in strict accordance with the requirements of technical standards of relevant breeding, especially the site selection and construction of these farms, storage of livestock and poultry wastes, and land use. The domestic scholars generally focused on qualitative research from the perspec-

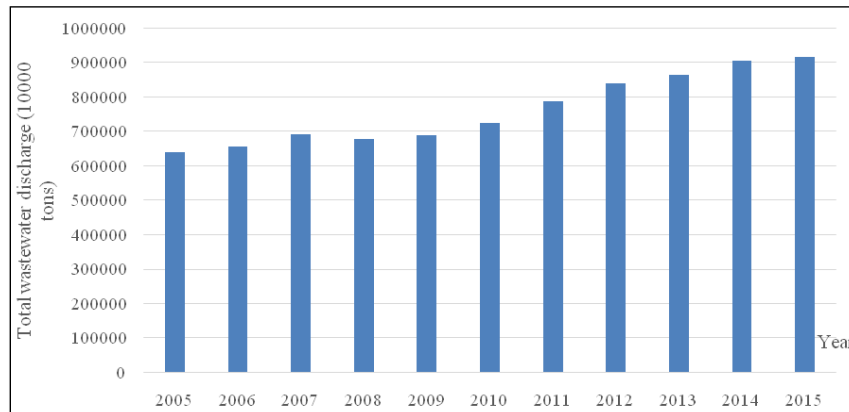


Fig. 2: Total wastewater discharges in Guangdong Province from 2005 to 2015.

tives of fundamental theory, pollution status, cause analysis, control technologies, and countermeasures. Most of their studies were centered on environmental science, economy, and agricultural technology. Moreover, in-depth analysis on the manner of controlling the livestock and poultry pollution from the legal perspective is rarely undertaken. Therefore, by analysing the hazards of livestock and poultry breeding pollution in Guangdong Province, corresponding legal measures for ecological control were proposed to solve the environmental pollution problems of livestock and poultry breeding and provide a reference for developing legal pollutions in this respect in China.

CATEGORIES OF POLLUTION HAZARDS OF LIVESTOCK AND POULTRY BREEDING IN GUANGDONG PROVINCE

Soil pollution: Soil, which contains water, fertility and nutrients to meet the smooth growth demand of plants, is a natural substance formed on the earth's surface. Soil quality directly affects the growth of the plants in it. In some rural areas of Guangdong Province, the livestock and poultry excrements are piled on farmlands. When the livestock and poultry wastewater penetrates the surface soil, the originally soft soil may harden, and the air and water permeability of the soil may decrease, thereby affecting its ability to provide water and nutrients for plants. The decline in soil quality means the decreasing quality and quantity of relevant agricultural products. Moreover, as fodders with additives are vigorously used for livestock and poultry, heavy metals (such as lead, copper and zinc) in it will be discharged from their bodies together with their excrements and penetrate the soil. Heavy metal enrichment causes the soil to absorb and digest all of them, thereby changing the soil structure and functions. To some extent, this phenomenon hinders

the normal growth of animals and plants. Moreover, long-term use of livestock and poultry wastewater for irrigation of farmland will disrupt the natural crop growth, affect crop yield and quality and causes farmland pollution. The decline in soil quality will threaten the growth environment of crops.

Water pollution: Some livestock and poultry breeders in Guangdong Province often directly discharge the livestock and poultry excrements and the sewage from washing breeding houses into the adjacent rivers or lakes without prior treatment. The enrichment of chemical elements (such as nitrogen, phosphorus and potassium) in the sewage easily causes the eutrophication of bodies of water. Therefore, algae grows rapidly and dissolved oxygen decreases significantly, and these will smother the aquatic animals and plants. Continuous discharge of large amounts of livestock and poultry breeding wastewater heavily pollutes the water and cause it to be smelly, as shown in Fig. 2. Moreover, this becomes an important part of total wastewater discharges. The wastewater forms a backwater and even a swamp, and causes the water to deteriorate and kill aquatic animals, such as fishes. The livestock and poultry sewage penetrates the groundwater circulation system from surface runoffs, and toxic and harmful substances are buried in the soil and rocks. The circulation takes a long time; therefore, detecting these substances is difficult. Once polluted, the body of water is not easily restored to its normal state. After the bacteria and parasites in the livestock and poultry wastewater are absorbed through the drinking water or the food chain, various infectious diseases will be induced, endangering human health and security.

Air pollution: For the livestock and poultry breeding farms in Guangdong Province that are unable to treat the pollutants, when the malodorous gas from the waste accumulates

to a certain level, the air quality will be affected, because ammonia, hydrogen sulfide, faecal matter and methane in these gases exhibit a highly irritating smell. Several toxic and harmful gases produced by the fermented livestock and poultry excrements will enter the atmosphere and will continuously spread and severely affect the air quality. This will pose a threat to human beings and other creatures in a wide range, especially during windy days or in areas with frequent air convection, and further affect the growth of plants. The vicious cycle will cause nearly impossible pollution control. Moreover, the surrounding living environment will be severely polluted as well.

CAUSES FOR POLLUTION HAZARDS OF LIVESTOCK AND POULTRY BREEDING IN GUANGDONG

Unreasonable layouts of traditional livestock and poultry breeding: Traditional livestock and poultry breeding in Guangdong are mostly located in rural areas by individual breeders and small-scale operators. Farmers breed livestock and poultry as a sideline business for their household and backyard breeding is common. Intensive agriculture leads to intensive animal breeding zones within the breeding industry. With the increasingly intensifying business and expanding scale, the resulting large quantities of animal waste may cause severe pollution to surrounding areas and deteriorate the entire rural area if they are not timely handled and arbitrarily piled up inside residential quarters.

Extensive livestock and poultry breeding: Traditional extensive breeding patterns are still maintained in most livestock and poultry breeding regions where animal faeces elimination through a natural course and coordinated with other industries are ignored. As a result, the perniciousness of faeces is not eliminated and severe environment pollution is caused. As the intensification, scale-up development, and industry competition of livestock and poultry breeding continuously develop, phenomena, such as the abuse of antibiotics, vitamins, and hormones during production, result in residues in animal products and environment pollution.

Backward disposal level of livestock wastes: The livestock and poultry breeding industry of Guangdong have developed rapidly in recent years. Its production scale continues to expand and the production, supply and sales of animal products, as well as intensive husbandry farms, are gradually moving from rural areas to suburban areas, thereby leading to the separation of agriculture and husbandry. Likewise, pollution hazards can result if these animal manures are not timely applied to crops. Few large-scale husbandry farms are equipped with equipment, such as biogas digest-

ers that are dedicated for handling faeces and most farms do not perform biosafety disposal of livestock and poultry faeces. Most individual breeders pile up animal faeces and breeding residues on the streets arbitrarily or discharge them into rivers and cause long-term and severe environment pollution.

Weak prevention and treatment of livestock and poultry breeding pollution: The environmental join-in standard for livestock and poultry breeding in Guangdong is yet to be improved; therefore, some husbandry farms are poorly equipped, incompletely designed, and lack necessary pollution disposal equipment. Most breeders possess poor environmental awareness, minimal professional livestock, and knowledge of poultry pollution control and scientific disposal methods, thereby worsening the pollution. Meanwhile, inadequate supervision in rural areas and agriculture environments, impeded coordination and cooperation among the authorities governing the livestock and poultry breeding business, and poor environmental monitoring and law enforcement create the vicious circle of livestock and poultry breeding industry in this region and probably worsening the rural environment.

LEGAL MEASURES FOR THE ECOLOGICAL CONTROL OF LIVESTOCK AND POULTRY BREEDING POLLUTION

Laws governing the control of livestock and poultry breeding pollution in rural areas shall be completed: The existing "Regulation on the Prevention and Control of Pollution from the Breeding of Livestock and Poultry" merely governs husbandry farms at large scale and may not cover the breeding pattern that accounts for the largest proportion in rural areas. The regulation is of a relatively low level and presents no uniform provisions that regulate the discharge of livestock and poultry faeces. Thus, the availability of the regulation shall be strengthened during its enforcement. Large-scale husbandry farming is the ultimate trend as livestock and poultry breeding in rural areas develops. Moreover, many specialized breeding households and individual breeders still operate. Individual breeders only breed a fairly small number and have enough space for faeces, which translates to minimal impact on the rural environment. As for the numerous specialized breeding households, the pollution caused by the waste from their centralized bred livestock and poultry is not second to those of large-scale husbandry farms. Animal carcasses shall be appropriately dismembered and mixed with substances, such as wood bits, and buried underground for fermentation, or the carcasses can be deep-frozen to kill all germs and viruses, reducing the risk of disease propagation. Guided by the "Regulation on the Prevention and Control of Pollution from the Breeding of Live-

stock and Poultry”, in combination with other applicable environmental laws and regulations, local authorities shall timely formulate local laws in which all terms are well defined and quantified based on the status quo of the local breeding scale and pollution. This aspect includes highly operable or executable terms, such as the maximum number of animals raised in a certain area of land or the time and frequency of field returning. The development of livestock and poultry breeding shall be supported with the ideas of circular economy, thereby reducing the disposal of pollutants from the beginning.

Law enforcement agency against the rural environment with power and responsibility shall be established: An agency that comprehensively governs the pollution in rural environments shall be established. This may prevent and handle the pollution from agricultural production, industrial production, and domestic pollution in rural areas systematically. The authority of the agency shall be well-defined internally, and specific responsibilities shall be fully implemented, thereby avoiding situations, such as ambiguous authority and evasiveness among authorities governing agriculture, forestry, water conservation, land, ocean, and fishing ports during monitoring and performance. Rural areas are massive lands; therefore, an environment protection station or environmental supervisor can be established or appointed at the village level to monitor and administer the situations of industrial pollution, agricultural pollution, and domestic pollution in the village on a regular or irregular basis. In any major livestock and poultry breeding pollution incident, all available manpower and equipment shall be deployed for treatment for the first time. The incident shall be reported to the local environmental authority. Moreover, an investigation team shall be organized by the local village or town government to investigate the origin, course, and person directly responsible of the incident. Furthermore, villages or villagers that might be endangered shall be timely informed, and the investigation results shall be timely disclosed to the public.

Supervision of the law enforcement against rural environment shall be strengthened: The right to be informed on the situation of rural environments and law enforcement foregrounds the public participation in supervising environmental law enforcement. The environmental law enforcement authority shall timely disclose the status, manifestation pattern, and main features of rural environment pollution, as well as the foundation, measures, and results of their enforcement. Township and village enterprises shall truthfully report their manner of waste disposal, thereby guaranteeing effective participation and supervision of the public over rural environment pollution control. Guaranteeing the

right of participation serves as the very core of the public participation in environmental law enforcement. The level of public participation and the transparency of all enforcement procedures shall be deepened, as well as the objective evaluation of the validity and feasibility of environmental law enforcement and suggestions regarding inadequacies. When construction projects seriously violate or potentially threaten the environmental rights and benefits of citizens, a hearing, field investigation, or other approaches shall be conducted to listen to public opinions and suggestions. Law enforcement authorities or staffs that have violated the environmental rights and benefits of citizens and caused personal and property damages shall be held legally accountable. Specifically, systems and measures on the right of citizens to participate in environmental law enforcement should be guaranteed. Moreover, the executive force and efficiency of environmental law enforcement in rural areas must be improved. Thus, the tasks, policies, and measures of rural livestock and poultry breeding pollution control of the government will be realized.

System of compensation for rural environment pollution damages shall be improved: To enable victims of environment pollution and civil environmental organizations to safeguard personal environmental rights and benefits or public interests through legal actions, as well as prevent polluters from disregarding their obligations to compensate and encourage them to actively engage in environment pollution control, improving the existing system of compensation for environment pollution damages is necessary. The pollution damage in rural areas includes the pollutant discharge and potential or indirect harm to the rural ecology or human health. The range of compensation for the rural environment pollution damages shall be consistent with the range of pollution damages, wherein the polluters not only have to be held accountable for the direct losses arising from pollution, but also indirect losses of ecological environment being affected, as well as all potential losses on all living beings, including humans.

Construction of legalization toward agricultural industry organizations shall be strengthened: Agricultural industry organizations reflect and represent the overall interests of farmers. The organizations shall perform self-administration and self-discipline based on the voluntariness and union and regard serving farmers instead of making profits as their purpose. Moreover, individual farmers shall be united through systematic and professional management and services as a community of interests. As the representative of vulnerable groups in the society, agricultural industry organizations may provide opportunities for their members to communicate with advantaged groups equally and express

the interest demands and expectations of livestock and poultry breeders from the government by striving for policies and measures that are conducive for the development of the livestock and poultry breeding industry. Moreover, they should aid plans for livestock and poultry breeding pollution control. The behaviour of breeders shall be regulated to maintain a market of orderly competition. Furthermore, enabling the livestock and poultry breeding industry to prosper in the rural economy and improve farmers' income, as well as constructing agricultural industry organizations, shall be strengthened to provide support and help among rural breeders to undertake the required social responsibilities for solving the livestock and poultry breeding pollution.

CONCLUSION

The environmental pollution hazards caused by livestock and poultry breeding severely restrict the sustainable development of this industry. Influenced by breeding structure, breeding layout, excrement disposal, and the implementation of the current legal policies for a long time, the livestock and poultry pollution can lead to water, soil, and air pollution. The categories of pollution hazards of the livestock and poultry breeding are summarized using the livestock and poultry breeding in Guangdong Province as an example. The causes for these hazards were explored and legal measures for the ecological control of livestock and poultry breeding pollution were likewise proposed. The results suggested that the livestock and poultry pollution is finally reflected in soil, water and air pollution. The major causes for such pollution are unreasonable traditional breeding layout, extensive breeding mode, backwards disposal of breeding waste, and poor prevention and control of breeding pollution. Five specific legal measures were thus proposed, namely, improving the legislation for controlling the livestock and poultry breeding pollution in rural areas; establishing a rural environment enforcement agency of uniform power, authority, and responsibility; strengthening the supervision mechanism for rural environmental law enforcement; improving the damage compensation system for rural environmental pollution; and enhancing the legal construction of agricultural industry organizations. This study focuses on analysing the categories and causes for

livestock and poultry pollution hazards and proposes prevention and control measures; therefore, future studies should be centered on adjusting the livestock and poultry breeding layout. Optimizing the livestock and poultry breeding structure, exploring new breeding techniques, and promoting multiple livestock and poultry excrement processing techniques should be performed as well.

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