DIFFUSE POLLUTION FROM LIVESTOCK FEEDING IN CHINA

Xiaoyan WANG

College of Resource, Environment & Tourism, Capital Normal University, Beijing 100037

ABSTRACT

With economic development and living standard improvement, livestock and poultry breeding have grown rapidly, also have become the leading source of pollution in vast rural areas in China. The estimated annual loss amount of COD, BOD NH_3-N from manure in 2001 is 7.28 million ton, 4.99 million ton, 1.32 million ton, respectively. In which COD loss amount from manure is near to the sum of COD from industrial and municipal waster water. Because animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and non-agricultural application of manure to cropland, this contamination has resulted in degraded quality of surface and underground drinking water supplies. Areas with concentrated livestock operations are showing elevated nutrients and organic pollutant contents in surface waters. This widespread contamination of water has prompted government to adopt regulations and practices which restrict the spreading of livestock pollution.

KEYWORDS: Diffuse pollution; Livestock; China

INTRODUCTION

Since 1960s, with the increasing demand of meat and eggs, livestock industry had changes into mechanical production at a large scale in the developed countries. By confining animals to areas or lots, farmers can efficiently feed and maintain livestock. But these confined areas become major sources of animal waste. Direct drainage of manure into surface water and leaching from saturated soils is a feature associated with industrial systems. In areas with high livestock concentrations, the spreading of manure on land can lead to nitrogen leaching into water. Because animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and non-agricultural application of manure to cropland, this contamination has resulted in degraded quality of surface and groundwater drinking water supplies. Increasing nutrient levels can cause excessive growth of aquatic plants and algae. The decomposition of aquatic plants depletes the oxygen supply in the water, creating anoxic or anaerobic conditions, which can lead to fish kills. Amines and sulfides are produced in anaerobic waters, causing the water to acquire an unpleasant odor, taste, and appearance. Such waters can be unsuitable for drinking, fishing, and other recreational uses. Dissolved ammonia at concentrations above 0.2 mg/L may be toxic to fish. Phosphates, although less mobile than nitrates, can cause similar problems, such as eutrophication and damage to the aquatic and wetland ecosystems. The ultimate effect is loss of bio-diversity. NH_3 volatilization contributes to acid deposition, while N_2O emission plays a role in global warming and in the deterioration of the ozone layer.

The water contamination made by its excrements has mostly aroused general concern. It is more important that the contamination of the surface water and groundwater caused by using of manure to the fields. On the basis of national statistical data from different years and research results in China, the main objective of this paper is to show the current situation of livestock pollution and the management in China.

METHODS

Based on the national statistical data of livestock industry, waste charge rate and research results on livestock pollution from specific sites, the main objective of this paper is to show the current situation of livestock pollution and the management in China.

RESULTS AND DISCUSSIONS

The development of Livestock industry

In the past of 18 years (1980-1998), China's livestock product just grew and grew. It is estimated that the meat output reached 54.1 million ton in 1998, an increase of 4.2 times over 1980. The increase rate of chicken and pork are much higher than that of cattle for the reason of longer period of big investment for cattle farm, and long feeding period of cattle. With the development of people's living standard, farms of milk cattle and meat cattle increase rapidly.

It has been investigated that 90 percent of animal farms nationwide were built lack pollution-prevention facilities. About 80 percent of large and medium-sized poultry and livestock farms are located in densely-populated areas in east China, and around major cities such as Beijing and Shanghai.

Increased densities in the geographic distribution of animal production have led to excess quantities of nutrients in animal producing regions. Even most animal waste is applied to the land as a source of nutrients, the intensification of the animal industry has created a situation of gross excesses of certain nutrients being land applied.

Table 1 The number of livestock breeding from the year of 1985 – 1995 in China (in million)

Year	Cattle	Pork	Chicken
1985	8682.1	23875.2	52369.1
1986	9166.7	25712.5	65586.7
1987	9465.7	16177.1	78777.5
1988	9794.8	27570.3	94290.0
1989	10075.4	29023.3	107790.9
1990	10288.4	30991.1	122880.3
1991	10459.2	32897.1	161019.9
1992	10784.1	35169.7	200183.5
1993	11315.7	37823.2	239315.5
1994	13221.8	42103.2	280505.2
1995	13206.0	48051.0	305750.7

Source: China Statistical Yearbook, 1997. State Statistical Bureau, People's Republic of China

Table 2 Average increase of livestock, poultry per rural household from the year of 1985 - 1996 (in kg)

Period	1985~1994	1985 1989	1990~1994
Cattle	4.7	3.8	6.5
Pork	6.5	5.0	8.0
Chicken	20.5	19.8	22.9

Source: China Statistical Yearbook, 1997. State Statistical Bureau, People's Republic of China.

The situation of livestock pollution in China

Society demands not only safe and sufficient food of a high quality, but also clean production methods. Pollution from livestock feeding to the environment should therefore be minimized.

According to the State Environmental Protection Administration (SEPA) survey on polluting conditions relating to nationwide livestock and poultry breeding, the general load of animal waste has approached an alarming level, while less than 10 percent of the current total breeding farms having experienced an environmental impact evaluation.

Animals on farms produced 1.9 billion ton of excrement during 1999, a quantity almost 2.5 times greater than the amount of solid waste discharged by China's industrial sector (Zhang Cungen, 2001). The estimated annual loss amount of COD, BOD NH_3-N from manure in 2001 is 7.28 million ton, 4.99 million ton, 1.32 million ton, respectively. In which COD loss amount from manure is near to the sum of COD from industrial and municipal waster water. Furthermore, the breeding amount of mid-small-size livestock farms is nearly 70% of the total amount nationwide. So the pollution cause by such farms, may be the main problem.

There are more than 800 concentrated livestock farms in Beijing up to now. The total waste amount in 2000 is up to 304.42 million ton, including COD 93434 ton, NH_3 N 8759 ton, TN 18460 ton, TP 7030 ton (Xu qian, et al., 2002). Based on the monitor on some densely-populated areas in Beijing, the concentration of COD is 53 times over the limit, BOD 76 time over the limit, SS 14 times over the limit. In Shanghai, there are more than 1600 large-scale and mid-scale livestock farms, annual waste amount is 700 million ton. Livestock pollution has already become the most leading and serious source around the rural areas in Shanghai. In Guangzhou, annual waste amount is 473.193 million ton. Though the discharge of waste water from livestock breeding is just 1.25% of domestic waste water, discharge of COD is 1.5 times of that from domestic waste water.

Table 3 Daily waste discharge rate of livestock in China

	Solid excreta	Liquid excreta	BOD (mg/L)	COD (mg/L)	NH_3-N(mg/L)
Cattle	25000-30000	18000-30000	639-805	1100	12-55
Pork	2200-3000	3000	201	266	37.5 - 45
Chicken	75-100		6.5	4.5-9	0.12-1.8

On investigation and analysis of the feed, excreta, soil and waters of surface and underground in the livestock farms in Jiangsu Province with case region survey and nutrient analysis approaches, the nutrient cycling and management and environmental effect in intensive livestock production were assessed. The studies show that the discharge of liquid manure and the run-off loss of solid manure deposited in the open air are the main environment problems in livestock production. The connection among the surface waters and the surface run-off are two main approaches that the wastes in livestock production cause the environment problems. The liquid manure is still a major source of environmental pollution, although the way of separating solid and liquid manure reduces the environmental effect in certain extent (Yang, et al., 2001).

Table 4 Concentration of waste water from different livestock farms in Beijing (Xu, et al., 2002)

	Treatment of excreta	COD (mg/L)	NH_3-N(mg/L)	TN (mg/L)	TP (mg/L)
Pork	dry	1560-46800	127-1780	141-1970	32.1-293
	water	2510-2770	234-288	317-423	34.7-52.4
Cattle	dry	887	22.1	41.4	5.33
Milch cow	dry	918-1050	41.6-60.4	57.4-78.2	16.3-20.4
Egg-chicken	water	2740-10500	70-601	97.5-748	13.2-59.4
Duck	dry	27	1.85	4.7	0.139

Table 5 Concentration of water near pork farms in Nanjing, China (Yang, et al., 2001)

Water sample	TN (mg/L)		TP (mg/L)	
	average	range	average	range
pond	34.7	2.57-66.83	6.486	4.306-8.665
river	10.62	2.00-29.27	0.207	0.066-0.289
underground	2.11	2.00-2.14	0.470	0.031-1.198

To determine the risk of excess excreta used to land is to estimate how many acres of in-county cropland will be eligible to receive poultry litter. This is combined with information on the amount of livestock litter produced in each county to estimate the amount of litter that could be used for in-county land application (Ding, 2000; Liu, 2001).

Management of livestock pollution in China

In attempts to address the environmental impact from livestock, many countries have taken measures of legislation and guidelines. However, approaches to controlling the environmental pollution caused by livestock production in different parts of the world are varied. These procedures adapted by most countries, can be divided into two categories, legislation and guidelines. Netherlands, Denmark have strict legislation to control the animal manure pollution.

Shanghai Municipal government firstly issued the regional standards to control discharges of manure in 1995, then revised in 1997. After several years practice, State Environmental Protection Agency (SEPA) of China has issued the first national

standards to control discharges of manure in 2002. The new rules specify the maximum amount of discharges confining animal areas can produce, as well as limiting distances between bred lot and residential areas or water supplies. It is valid in Jan. 1, 2003.

This Standard divided the concentrated farms into two levels (See Table 6). The breeding amount at the level 1is 40 % of the total breeding amount. The breeding amount at the level 2 is 70% of total breeding amount.

Table 6-1 Available standard for livestock and poultry breeding farms (Q)

Level	**Pork** 25Kg	Egg chicken	Meat Chicken	Milk cattle	Meat cattle
1	3000	100000	200000	200	400
2	500 Q < 3000	15000 Q < 100000	30000 Q < 200000	100 Q < 200	200 Q < 400

Table 6-2 Available standard for livestock and poultry breeding areas(Q)

Level	**Pork** 25Kg	Egg chicken	Meat Chicken	Milk cattle	Meat cattle
1	6000	200000	400000	400	800
2	3000 Q < 6000	100000 Q < 200000	200000 Q < 400000	200 Q < 400	400 Q < 800

Table 7 Daily maximum discharge standard of pollutants for livestock and poultry breeding

	BOD (mg/L)	COD (mg/L)	SS (mg/L)	NH_3-N (mg/L)	TP (mg/L)	Feces Coliform (per 100ml)	Ovum of ascarid (per 1L)
Limit Value	150	400	200	80	80	1000	2

Future prospects for this problem

There are three reasons for the serious pollution caused by livestock and poultry breeding. First, poor farm layout; second, most breeding farms don't have cultivated land to dispose of animal waste; third, preferential policies concerning the disposal of animal waste are very much needed. A solution to some of these problems is seen in the possible decentralization of poultry and livestock breeding areas and the education on integrated organic methods of waste disposal. In order to control and utilize animal waste, there are many ways to do in the future:

- Better estimates of the land carrying capacity of livestock; limit the breeding livestock and manure amount to the land.
- Based on the regional soil condition and meteorological data, confirm the livestock loading.
- Enhance awareness of farmers
- Enact economic and legal policies to incentive farmers to take proper actions to reduce livestock pollution.

CONCLUSIONS

The contamination of water bodied by livestock manure is very common in China. To improve livestock pollution management, a sustainable development of livestock raising should be enhanced to make a regional balance between livestock and crop production activities.

ACKNOWLEDGMENTS

This study is supported by National Ministry of Education and Beijing Municipal Scientific New-Star Plan. Thanks to the Water soil Protecting Station of Miyun County for help in the fieldwork.

REFERENCES

Ding Jianghua, The pollution of poultry and animal feces and the countermeasures in Guangzhou, Research of Environmental Sciences, 2000, 13 (3): 57-59

Doug Parker, Controlling agricultural nonpoint water pollution: costs of implementing the Maryland Water Quality Improvement Act of 1998, Agricultural Economics, 2000, 24: 23–31

Edwards,D.R. and Daniel, T.C., Quality of runoff from fescue grass plots treated with poultry litter and inorganic fertilizer, J. Environ. Qual., 1994,23(3):579-584.

FAO, Livestock and the Environment: Finding a Balance. 1997, 115

Liu peifang, Chen Zhenlou, Xu shiyuan, Liu jie, Waste loading and treatment strategies on the excreta of domestic animals in the Yangtze Delta, Resource and Environment of Yangtze River Watershed, 2001, 11(5): 456-460

P.S. Hoodaa, U, A.C. Edwardsb, H.A. Andersonb, A. Miller, A review of water quality concerns in livestock farming areas, The Science of the Total Environment, 2000, 250:143-167

J.J. Neeteson, Nitrogen and phosphorus management on Dutch dairy farms: legislation and strategies employed to meet the regulations, Biol Fertil Soils, 2000, 30: 566–572

Steinfeld H, De Haan C, Blackburn H., Livestock-environment interactions: issues and options. European Commission Directorate-General for Development, 1997, 56

U.S. Environmental Protection Agency, National management measures to control nonpoint source pollution from agriculture (Draft). Chapter 4D: Animal Feeding Operations (AFOS). 2000,107-128.

W.F. Ritter, Nonpoint source pollution and livestock manure management. *Watershed Management and Hydrology*. CRC Press LLC,2001, 136-158.

Xu qian, et al., Pollution from large-scaled livestock and poultry breeding-farms in Beijing and its control, Rural Environmental Science, 2002, 18(2): 24-28

Yang Jinsong, Chen De-ming, Liu Guang-ming, Li Hai-feng, Nutrient cycling and environmental effect of livestock production in case regions of Jiangsu Province. China Environmental Science. 2001, 21(5): 468-471

Zhang Cungen, Review of the livestock revolution in China, Implication of Asian economic crisis for the livestock industry, 2000, 203-213