



Study on Livestock Manure Processing and Utilization in Daqing City

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Abstract: This study aims to clarify the pollution status and provide suggestions for pollution treatment of animal husbandry industry by estimating the quantity of main animal manure and the pollutant contents in Daqing area. Based on the related statistic data in 2013 and the excreta coefficient of different animals, the feces and its pollutant production amount of main livestock and poultry in Daqing were evaluated. We evaluated the pollution amount of main livestock and poultry of Daqing. The results show that the output of livestock manure, urine in Daqing in 2013 are 12.69 million t and 5.00 million t respectively. So based on the situation of domestic animal and husbandry in Daqing City, the study analyzed the amount of manure generated by livestock and its influence on the environment in five districts and four counties. This study also analyzed main mode of processing the manure and how the mode was used. The methods controlling the manure and urine pollution was given in this study.

Keywords: Animal husbandry, Manure, Pollution, Environment, Daqing

1. Introduction

Daqing City is one of the one-hundred-developed cities in China. Thanks to its unique economic, technological, and cultural resources, the animal husbandry develops unprecedentedly well and it plays a vital role in the rural economy. Vigorous development of livestock and poultry breeding industry in daqing brings enormous economic benefits. Since the introduction of "farming turns into husbandry" strategy, Daqing city vigorously develops cow products, and the population of dairy cattle has reached 571,873 heads, forming an industrial band represented by Duerbote County, Lindian County and Ranghulu District. Dairy industry has now become the primary part for animal husbandry in Daqing City. As is known, with the ever-increasing market demands of the poultry and domestic animal products, the large scale and intensive breeding farms have been developed rapidly, so the large amount of animal dung becomes a serious problem of environment pollution.

In order to solve this problem, many scholars have done much work. At the early of the 1990s in China, firstly introduced the excretion coefficient to estimate the production amount of livestock and poultry manure in Shanghai suburbs [1]. Besides, many provinces and cities, including Chongqing [2], Heilongjiang [3], Hainan [4], Gansu [5] and Beijing [6], have launched survey on pollution of livestock and poultry breeding industry. But at the same time, many foreign experts and scholars have also done a lot of research [7-10].

However, the cow product universally lacks of normed environmental management and technologies. The inappropriate disposal of manure, urine and castoff threaten the environment in various degrees [11, 12]. Livestock and poultry contamination has become major source of rural diffused pollution. The paper makes a systematical analysis of the influence of cow product on the environment. In addition, it also offers some suggestion to the environmental pollution prevention and its relevant work.

2. Analysis of pollution in domestic animal and poultry farming:

2.1. Analysis of quantity of manure from livestock and poultry

Basic data of this study was selected from Daqing Statistical Yearbook 2014, with the end of 2013 as deadline of incorporation. The quantity of excrement and urine is estimated according to the amount of livestock and poultry on hand. With the relevant parameter [13, 14], the estimation details are demonstrated in Table 2 and Table 3.

The two tables show that animal excrement and urine are apparently increasing with each passing year in Daqing and by 2013; there had been 12.69 million tons livestock and poultry excrement and 5.00 million tons of urine, which means that animal excrement and urine in Daqing City have increasingly become an important issue which affects the development of animal husbandry. The excrement trend and the scale of excrement of kinds of livestock and poultry in Daqing City are shown in Figure 1, and Figure 2.

Table 1: The manure excretion coefficient of livestock and poultry

Manure	Daily excretion coefficient(Kg/d)				
	cow	beef cattle	pig	sheep	poultry
Excrement	25	15	2.21	2	0.478
Urine	10	4	3.64	0.66	-

Table 2: The dejecta release from the main livestock and birds in Daqing these years (unit: million tons)

Year	Cow	Beef cattle	pig	Sheep	Poultry	Total
2004	2.31	1.36	0.79	0.79	1.61	6.87
2005	2.74	1.47	0.81	0.68	1.65	7.34
2006	2.52	0.85	0.61	0.51	1.40	5.89
2007	2.84	0.90	0.66	0.54	1.49	6.43
2008	3.37	1.12	0.83	0.69	2.19	8.19
2009	3.93	1.16	0.94	0.73	2.44	9.20
2010	4.43	1.35	1.05	0.79	2.79	10.41
2011	5.03	1.61	1.18	0.83	3.20	11.85
2012	5.49	1.76	1.38	0.89	3.34	12.86
2013	5.22	1.89	1.27	0.97	3.35	12.69

2.2. The difference comparison of livestock and poultry excrement quantity:

According to the data in 2013, the excrement ratio of each kind of livestock and poultry is calculated separately. From Figure 2, at present, the main source of animal excrement comes from dairy cows and beef cattle in Daqing City whose droppings have accounted for 55% of a total amount of animal excrement. From 2004 to 2013, dairy cow excrement has grown fast, whereas the quantity of excrement from other livestock and poultry either decreases or changes not so much.

Table 3: The excretion from main livestock and birds in Daqing these years (unit: million tons)

Year	Cow	Beef cattle	Pig	Sheep	Total
2004	0.92	0.36	1.30	0.26	2.85
2005	1.10	0.39	1.33	0.22	3.04
2006	1.01	0.23	1.00	0.17	2.41
2007	1.14	0.24	1.09	0.18	2.65
2008	1.35	0.30	1.36	0.23	3.23
2009	1.57	0.31	1.54	0.24	3.66
2010	1.77	0.36	1.73	0.26	4.12
2011	2.01	0.43	1.94	0.27	4.65
2012	2.20	0.47	2.28	0.29	5.24
2013	2.09	0.50	2.09	0.32	5.00

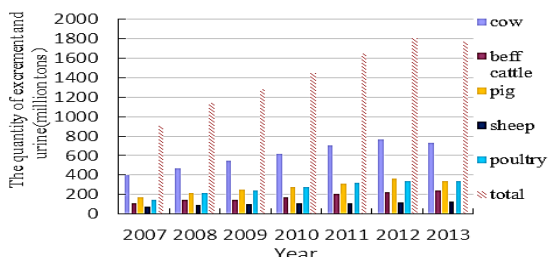


Figure 1: The dejecta release from the main livestock and birds in Daqing these years

In 2013, dairy cows and beef cattle excrement accounted for 55% of total excrement in Daqing City, much higher than the volume of other livestock and poultry's defecation. While developing dairy cows in Daqing, animal excrement has been increasing year by year and cattle-raising has become a major source of animal excrement in Daqing, which means the disposal of animal excrement will mainly revolve around cattle excrement.

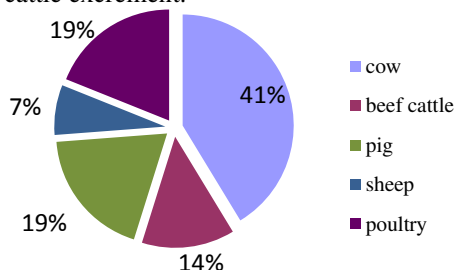


Figure 2: The contrast of dejecta release from the main livestock and birds in Daqing in 2013

2.3. Analysis of environment pressure from livestock and poultry excrement:

In order to analyze the impact of excrement on environment, two indicators are used, that is: land-carrying capacity and per capita load [9, 10].

2.3.1. Analysis of Land-carrying capacity for livestock excrement: According to the quantity of livestock excrement over the years and land area, the land-carrying capacity is estimated. Specific results are shown in table 4. Calculation results show that the land-carrying capacity in Daqing City tends to be steady in recent years, which is between 16-17 t. According to the project findings of "Prevention and Control of Pollution in Domestic Animal and Poultry Farming of national scaled livestock breeding" organized by State environmental Protection Administration, the maximum amount of animal excrement per hectare is theoretically 30t from the point of environmental risk. If it is above this level, the soil will suffer from eutrophication, which has adverse effects on the environment. Although the Daqing excrement load does not reach the maximum limit of 30 t, the number is close to the half of that, if coupled with the amount of urine, it is far exceeding the limit.

Table 4: The annual average burthen of plantation bearing cow's feces in Daqing these years (unit: t/hm²)

Year	2009	2010	2011	2012	2013
Excrement Burden	13.26	14.37	16.15	17.12	16.90
Urine Burden	18.54	20.06	22.49	24.09	23.55

2.3.2. The analysis of per capita load of manure:

According to the total population in Daqing City from 2007 to 2013 and the total amount of livestock and

poultry excrement and urine, the per capita load of livestock and poultry excrement and urine in Daqing City is estimated in table 5.

Table 5: Livestock waste of Daqing per capita amount in in recent years

Year	2009	2010	2011	2012	2013
Excrement per capita	3.28	3.72	4.21	4.57	4.49
Urine per capita	4.59	5.19	5.86	6.43	6.26

3. Analysis according to the District:

In order to figure out the contaminated differences of dairy cows between counties and districts in Daqing City, we must clearly know about the regional imbalances of pollution so that the pollution prevention work of dairy cow production can be carried out [11]. Therefore, it is necessary to make a systematic study based on the division of districts. According to the above analysis, 55% of the total amount is cattle excrement and, therefore, cattle excrement is as representation in this district analysis.

Table 6: Daqing city districts cow muck urinary excretion in 2013 (million tons)

District	Urban	Zhaozhou	Zhaoyuan	Lindian	Dorbor
Excrement	2.07	2.56	2.75	2.98	2.32
Urine	0.71	0.85	0.94	0.98	0.67

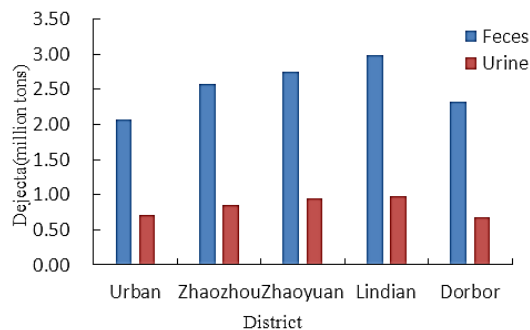


Figure 3: The feces and urinary excretion of cows in Daqing 2013

4. Results and discussion:

4.1. Estimation of the production amount of livestock and poultry manure

From table 5, due to the development of animal husbandry in Daqing City, per capita load per year is 4t excrement and nearly 6t urine. The population in the data contains both the people both in city and suburb, in fact, most farming are in the rural areas, so the rural people are having more livestock excrement pressure[5]. The excrement and urine contamination from livestock and poultry is a serious problem in Daqing City. By per capita load analysis, excrement and urine contamination is a serious problem in Daqing City. Great importance has to be attached to it

and effective measures also must to be taken to solve this problem [15].

4.2. The amount of dairy cow excrement in different counties and districts:

According to the number of dairy cows on hand in different counties and districts in 2013 (table 6), the amount of cow excrement is of each individual district and county is shown in Figure 3. Obvious imbalances of the amount of livestock excrement in each individual district and county can be seen from Figure 3. According to the amount of animal excrement production, the counties and districts can be divided into three areas:

Zhaoyuan County and Lindian County: the two counties produce the largest amount of livestock and poultry excrement and they are the key areas to deal with the pollution.

Zhaozhou County and Zhaozhou County: These three counties produce the medium amount of livestock and poultry excrement and they are the major areas to deal with the pollution.

Urban districts produce the least amount of livestock and poultry excrement and they are the common areas to deal with the pollution.

4.3. Disposal and utilization mode of livestock and poultry excrement:

The main approach of disposing and utilizing animal excrement in Daqing City is to use marsh gas. According to the survey and incomplete statistics, now there are 18 000 marsh gas tank, 20 biogas projects of 50m³ and one large biogas project of 2000 m³ in Daqing City. At present, in Daqing city, the disposal and utilization of animal excrement mainly uses ecological modes [16]. There are two major modes:

Household Methane which includes: the "Trinity" ecological disposal and utilization pattern with biogas as a link and "four in one" eco-mode. "Trinity" pattern is the main mode of utilization of livestock and poultry excrement in Daqing City.

Biogas project mode, Including small biogas project and large biogas project. Small biogas project generally refers to the project whose capacity is 50m³ while the large biogas project generally refers to the one whose capacity is more than 1 000 m³ [17].

Each county and district's processing mode differs from each other: Household Methanes are mainly in Lindian County, Duerbote County, Saertu District and Longfeng District; small biogas projects are mainly distributed in the Keertai village, Duerbote County, Longfeng town, Longfeng District and development zone, large biogas projects are distributed in Zhaozhou County. Household Methanes are applied to the majority of farmers, small biogas projects are suitable for large aquaculture family, medium-scale farms, and large biogas projects are suitable for farming

communities, concentrated excrement disposal of districts and counties.

Given the reality of Daqing City, the proper development of animal husbandry is recommended. The scale of animal husbandry development is not only in accordance with the resources in Daqing City, market demand but also considers the environmental protection. On the basis of district division of animal husbandry in Daqing City, we should set up different classes of contamination area and to develop appropriate solutions. According to the environmental characteristics of Daqing, we should determine and optimize different areas on the basis of mode and scale of breeding, and choose different modes of disposal and utilization of animal excrement, and make active application. At the same time, we should actively carry out scientific research to explore key technologies suitable for the disposal and utilization of animal excrement in north cold area, establish the appropriate technical system. We should emphasize on the integrity of agriculture and animal husbandry and on ecological ways and means of disposal and utilization of excrement. Meanwhile, we should actively develop circular economy and strive to convert excrement into resources and try to use the animal excrement in the chain of large agricultural industry [18]. We should closely combine the problem of animal excrement with the construction of new countryside. The Government should pay more attention to the biogas construction. Biogas project not only acts as a primary means of disposal and utilization of animal excrement, also as an important approach to solve the problem of rural energy. According to the breeding situations of districts and counties, we should make scientific distribution, rational mode selection of household biogas, small and large biogas projects in order to push forward the construction of biogas project and to thoroughly solve the problem of animal excrement.

5. Study on the disposal and utilization of excrement from livestock and poultry:

At present, the disposal and utilization of livestock and poultry excrement in Daqing per year is approximately 1.3 million tons, accounting for 9% of total livestock and poultry excrement. This shows that the ratio of processing and utilization of livestock excrement is extremely low in Daqing City and that the vast majority of livestock and poultry excrement does not receive a timely and efficient processing and utilization, which has huge impact on the overall environment in Daqing City and will be seriously harmful to the urban and rural people's living and production environment [11-16]. At that rate, by 2020, the Daqing annual processing power will reach about 2.6 million tons and the livestock and poultry excrement disposal rate will reach 18% livestock excrement pollution in Daqing City is still very serious. At present, the main disposal approaches are traditional excrement compost and sludge-gas

utilization. In the countryside, a majority of farmers use traditional method of excrement compost and a minority of farmers use sludge-gas utilization. In intensive farming and breeding areas, in addition to traditional approaches, biogas projects are using.

6. Conclusions:

The negative effects of animal husbandry in Daqing City are remarkable. Animal excrement will become the major source of environmental pollution in Daqing City if timely and effective measures are not taken. The dairy cows and beef cattle produce about 60% of the total amount of livestock and poultry excrement. Animal excrement distribution in each individual county is uneven. The more cattle the county has, the more excrement they produce. The processing and utilization ratio of livestock and poultry excrement is extremely low, it is just 9% of the total, the vast majority of livestock and poultry has not been disposed and utilized, which severely affects the living and natural environment for the rural and urban people.

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