Research on Utilization Status and Potential of Manure Resource in Liaozhong County

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***Abstract*—Based on regional fieldwork and Shenyang statistical yearbook data of aquaculture farmers and organic fertilizer companies, the paper describes the resource utilization status of livestock manure, compare the total nutrients contained in animal manure and chemical fertilizer and analyze a low level of using manure resources and other issues. The results show that: the total manure resources in the study area are 1,292,300 t, commercialization of organic fertilizer resource accounts for only 8.13% of the total, the farmers directly buying traditional fertilizers accounts for 55.87% of the total, idle discard manure 36.00%, organic fertilizer resources waste largely, manure pollution is more serious. From 2006 to 2012, the amount of the average replacement rate of the nutrients amount contained in manure and chemical fertilizer nutrients in the same period is 55.55%, manure resource development potential is huge. Based on this, the paper makes some suggestions.**

Keywords- Cycle of agriculture, Livestock manure, Resource utilization, Organic fertilizer

I. INTRODUCTION

In the past 20 years, Chinese livestock industry producing has grown rapidly, its scale and intensive are becoming more and more, so a lot of manure emissions are worsening environmental pollution and seriously affect human health [1-2]. From 2000 to 2012, China's pork, beef, mutton, milk and egg production have increased by 23.733 million t, 29.563 million t and 6.792 million t, the growth rate is 39.4%, 321.7% and 31.1%, respectively [3]. With the increasing demand for livestock products, the number and size of livestock and poultry industry continues to expand, while emissions from animal manure have increased significantly. In the 1980s, China's manure production was only 690 million t, to 2009, it has reached 3.264 billion t [4-5]. It is predicted that by 2020, China's manure emissions will reach 4.244 billion t [6].

In traditional agriculture, livestock and poultry is mainly backyard, organic fertilizer is absorbed by the surrounding farmland, but since the 1960s, organic manure fertilizer gradually replaced the declining proportion of organic fertilizer, a lot of manure is directly discharged with untreated, which caused severe pollution for the surrounding surface and ground water, soil and air, and caused great waste in resources [7-9]. For manure resource utilization, many scholars at home and abroad explore in different ways: some scholars analyzed from manure utilization methods, such as fertilizer, feed, fuel and industrial raw materials, some from the utilization of manure treatment technology research, such as drying treatment, deodorization method, incineration and comprehensive treatment method. some estimated from animal manure and energy resource potential evaluation of stock discussed, also some foreign scholars conduct research from livestock and poultry waste management and control methods.

To sum up, most of these studies are from the utilization of methods and techniques, the total estimation and evaluation level of energy potential, in part to analyze the management and monitoring of research, but literatures with comparative analysis of the amount of nutrients contained in the regional animal manure and chemical fertilizers in the same period are not much, especially there is little research analysis from the time perspective of the development potential of manure fertilizer. This paper takes Liaozhong country for example, and study area manure utilization status, and estimates the amount of manure nutrients contained in the stock for the last seven years, making comparative analysis of the use of fertilizers and manure nutrient content.

II. RESEARCH AREAS AND RESEARCH METHODS

A. Research objects and research methods

In this study, the range is livestock and poultry droppings in Liaozhong country, Shenyang City. The unit is country. The main research methods include literature review, field research and comprehensive comparative analysis method to estimate livestock excrement such as the combination of the stock.

B. Basic source of data and parameters

In this paper, the statistical data are mainly from "Shenyang Agricultural Statistical Yearbook" and "Shenyang Statistical Yearbook", animal health supervision

and management and the Environmental Protection Agency, the main livestock husbandry from 2006 to 2012 is in Table 1, by contrast analysis of different research scholars to determine the main parameters involved in the estimate.

Table 1 Number of main breeding livestock in study area (2006-2012)

Breeds	In 2006	In 2007	In 2008	In 2009	In 2010	In 2011	In 2012
Cow（head）	234686	235477	220019	295394	365981	408982	438638
Pig（head）	972983	867094	810182	857860	935877	1068851	1140442
Chicken（hundred）	162200	161400	160800	167800	200885	210600	229400

C. *Estimation of nutrient content and resource stock of manure*

1) Number of livestock and breeding cycle

The number of breeding livestock is determined according to their average breeding cycle. General average breeding cycle is less than a year. According to the survey, the majority of the study area cattle farmers are purchased from Xinjiang and Inner Mongolia and other places, therefore, the average cattle breeding cycle is 150 d, the average pig breeding cycle is 150 d, average broiler breeding cycle is 45 d.

2) Manure excretion coefficient

Combined with field survey data, take the average value as animal manure excretion coefficient, seen in Table 2.

Table 2 Excreta parameter of livestock in study area

Breeds	Breeding period（d）	Dailymanure quantity（kg）	Daily wastewater quantity（kg）	Period quantity of solid waste（t）	Period quantity of wastewater（t）
Cattle	150	12	15.33	1.8	2.3
Pig	150	2	5.33	0.3	0.8
Broiler	45	0.16	0	0.007	0

3) The main nutrient content coefficient of manure

According to the domestic livestock manure for fertilizer content in a variety of major research, take the mean value as the main nutrient content of livestock coefficient (Table 3).

Table 3 Content of main nutrition in livestock manure units: %

Breeds	Organic	N	P_2O_5	K_2O	Water
Cow	12.01	0.47	0.19	0.50	81.03
Pig	10.60	1.09	0.32	0.68	74.14
Chicken	21.58	1.41	0.90	0.78	56.00

D. *Calculation Method*

1) Livestock manure excretion estimation

$$Q_{ij} = N_{ij} C_i E_i, \quad i = 1, 2, \cdots, n$$

Where, Q_{ij} is the fecal excretion of livestock i in year j, N_i is the number of breeding of livestock i in year j, C_i is the breeding cycle of livestock i, E_i is excretion coefficient of livestock i, n is the variety number of livestock.

2) The main nutrient content resource estimation of livestock manure

$$N_{ij} = Q_{ij} \alpha_i, \quad i = 1, 2, \cdots, n$$

3) Agricultural fertilizer pure volume calculation

$$Y_{ij} = \sum_{i}^{n} F_{ij} \beta_{ik}, \quad i = 1, 2, \cdots, n \quad k = 1, 2, 3$$

III. RESULTS AND ANALYSIS

The total amount of animal manure emissions and major nutrient content can be seen in table4:

Table 4 Production of livestock manure and main nutrient in study area (2006-2012) units: t

Year	Breeds	Total	N	P_2O_5	K_2O	Total nutrient
2006	Cow dung	422434.80	1964.32	788.54	2112.17	4865.04
	Pig manure	291894.90	3167.06	929.20	1975.16	6071.41
	Fowl dung	113540.00	1602.81	1016.18	887.50	3506.49
	Subtotal	827869.70	6734.19	2733.93	4974.83	14442.95
2007	Cow dung	423858.60	1970.94	791.20	2119.29	4881.44
	Pig manure	260128.20	2822.39	828.07	1760.20	5410.67
	Fowl dung	112980.00	1594.90	1011.17	883.13	3489.20
	Subtotal	796966.80	6388.23	2630.45	4762.62	13781.30
2008	Cow dung	396034.20	1841.56	739.26	1980.17	4560.99
	Pig manure	243054.60	2637.14	773.72	1644.67	5055.54
	Fowl dung	112560.00	1588.97	1007.41	879.84	3476.23
	Subtotal	751648.80	6067.67	2520.40	4504.68	13092.76
2009	Cow dung	531709.20	2472.45	992.52	2658.55	6123.52
	Pig manure	257358.00	2792.33	819.26	1741.46	5353.05
	Fowl dung	117460.00	1658.14	1051.27	918.15	3627.56
	Subtotal	906527.20	6922.93	2863.05	5318.15	15104.12
2010	Cow dung	658765.80	3063.26	1229.70	3293.83	7586.79
	Pig manure	280763.10	3046.28	893.76	1899.83	5839.87
	Fowl dung	140619.50	1985.08	1258.54	1099.18	4342.80
	Subtotal	1080148.40	8094.62	3382.00	6292.84	17769.46
2011	Cow dung	736167.60	3423.18	1374.18	3680.84	8478.20
	Pig manure	320655.30	3479.11	1020.75	2169.77	6669.63
	Fowl dung	147420.00	2081.08	1319.41	1152.33	4552.82
	Subtotal	1204242.90	8983.37	3714.34	7002.94	19700.65
2012	Cow dung	789548.40	3671.40	1473.82	3947.74	9092.97
	Pig manure	342132.60	3712.14	1089.12	2315.10	7116.36
	Fowl dung	160580.00	2266.85	1437.19	1255.20	4959.25
	Subtotal	1292261.00	9650.39	4000.14	7518.04	21168.57

The agricultural chemical fertilizers and pure volume changes can be seen in Table 5:

Table 5 Fertilizer consumption and quantity of pure fertilizer in study area (2006-2012) units: t

Year	Total fertilizer	quantity of pure fertilizer				Total nutrient
		Nitrogen	Phosphate	Potash	Fertilizer	
2006	113618	18045	5303	3477	6638	33463
2007	93290	14603	3932	2914	6279	27728
2008	91123	14065	3222	4012	6445	27744
2009	96972	14746	3323	4304	7225	29598
2010	97298	14701	3318	4266	7409	29694
2011	97080	14690	3320	4189	7406	29605
2012	97213	14851	3308	4175	7310	29644

The comparison of fertilizer and manure nutrients and its substitution rate in study area from 2006 to 2012 can be seen in Figure 1, and the way of animal manure using in study area can be seen in Figure 2.

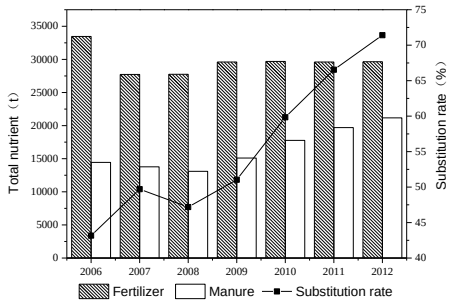

Figure 1 Comparison of fertilizer and manure nutrients and its substitution rate in study area

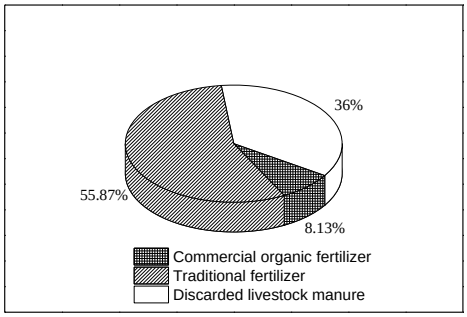

Figure 2 The way of animal manure using in study area

IV. CONCLUSIONS AND SUGGESTIONS

A. Conclusions

(1) The total amount of manure resources in the study area is 1.2923 million t, commercialization of organic fertilizer resources accounts for only 8.13% of the total, the farmers directly buying traditional fertilizers accounts for 55.87% of the total, idle discard manure 36.00%, organic fertilizer resources waste largely, manure pollution is more serious.

(2) From 2006 to 2012, the amount of the average replacement rate of the nutrients amount contained in manure and chemical fertilizer nutrients in the same period is 55.55%, manure resource development potential is huge.

B. Suggestions

Based on the above analysis, to make full use of manure resources to promote organic fertilizer industry and sustainable agricultural development, the paper makes the following suggestions: Strengthen the standardization of management in livestock and poultry farms and technical research, and solve key technologies in business of organic fertilizer utilization. Government provide subsidies to make organic fertilizer economy internalize externalities, strengthen organic fertilizer market standardized management, and introduce a series of positive macroeconomic policy guidance.

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