Pollutant coefficients data of livestock industry at provincial level in China

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Abstract: Based on a series of measures, such as unit transformation, livestock and poultry equivalent normalization, and errors correction etc., we produce pollutant generation coefficients of livestock industry dataset at provincial level in the mainland of China. This dataset includes six main species of livestock and poultry, which are dairy cattle, beef, pig, broiler, laying hen and draft cattle. In addition, this dataset can support more accurate computing and comparing researches on livestock and poultry pollutant production at provincial level.

Keywords: livestock and poultry; pollutant coefficient; provincial level; China
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1 Introduction

Pollutant coefficient of the livestock industry is an essential component of livestock and poultry's pollutant production estimation. There are two types of pollutant generation coefficient at home and abroad as follows:

The first one is fixed coefficient at national level, which is primarily used to reflect the average status of livestock and poultry's pollutant production for per day or per year at national or regional level. Countries, such as Japan[1-2], Denmark[3], America[4] and the former Soviet Union[5], all have fixed coefficients for pollutant production.

Another one is pollutant coefficient at regional level such as six major regions, Northeast, North, East, Central South, Southeast and Northwest China, coefficient, and many disperse province and county coefficients in published papers[6-43].

However, there still lacks an open available systemic livestock industry's pollutant generation coefficient at provincial level that greatly influences the estimation accuracy of livestock and poultry's pollutant production. Meanwhile it is hard to reveal the spatial difference of different provinces if we adopt fixed one or several coefficients. Therefore,

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Table 1 Summary of the LivestockPolluGeneCoeffi_China metadata

Full name of dataset	Pollutant coefficients of livestock industry at provincial level in China
Short name of dataset	LivestockPolluGeneCoeffi_China
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Geographical region	The mainland of China
Data format	Excel, .xlsx　　Dataset size　　16 KB
Data Publisher	Global Change Research Data Publishing and Repository, DOI:10.3974/
Data access and services platform	Global Change Research Data Publishing and Repository，http://www.geodoi.ac.cn/ National Data Sharing Infrastructure of Earth System Sciences of China, http://www.geodata.cn
Academic editors	LIU Chuang, SHI Ruixinag, WANG Zhengxing, HE Shujin
Data sharing policy	The authors of the dataset agree to publish the data here according to the Article I of Data Sharing Policy of the Global Change Data Publishing and Repository, which states that the dataset can be used freely for research, education, and decision making; any users for commercial uses should get formal permission from IGSNRR/CAS.

based on existing disperse coefficients published in various journals, we produce this dataset, the provincial livestock industry's pollutant generation coefficients of main livestock in China, by the process of unit transformation, livestock and poultry equivalent normalization, and errors correction etc.

2 Dataset description

The descriptions of the pollutant coefficients of livestock industry at provincial level in China (LivestockPolluGeneCoeffi_China for short) dataset are recorded. These information include the dataset full name, dataset short name, corresponding author, authors, geographical region of the dataset content, year of the dataset, number of the dataset tiles, dataset spatial and temporal resolution, dataset format and size, data publisher, data sharing platform and contact information, technical editors, foundation and the data sharing policy. Table 1 below summarizes the main metadata elements of the LivestockPolluGeneCoeffi_China dataset.

3 Methods

The dataset processing method references from the article of "Optimizing pollutant generation coefficients of livestock industry and mapping patterns of pollutant constitution in China" published in the Journal of Geographical Research[44].

3.1 Coefficient optimization

There are some problems in different provincial coefficients of published articles, such as the measurement methods are inconsistent, and livestock and poultry's species are not clear. The problems above result in hardly comparing pollutant production among different provinces. Therefore firstly according to the formula 1, we transform numerical unit of each provincial coefficient to uniform kg/day· head. For these coefficients, which do not include feeding period, we adopt the following fixed feeding days to transform them: 180 days for pigs, 55 days for meat poultries, and 365 days for dairy cattle, beef, laying hen and cattle.

$$g_{m,d} = g_{m,y} \div T_m, \quad g_{m,y} = Q_m \div Y_m \tag{1}$$

where $g_{m,d}$ is pollutant generation coefficient of each livestock and poultry in every day (kg/ day· head) while $g_{m,y}$ is pollutant generation coefficient of each livestock and poultry in every year.

In addition, for the problem of cattle's species of existing coefficients are almost obscure, we use the public criterion of 43-75kg/day· head to revise these data that are obviously lower than the above criterion according the formula 2.

$$1\ dairy\ cattle = 2\ beefs = 10\ pigs \tag{2}$$

There are 2 periods in pig's feeding, caring and fattening so we adopt piecewise calculation method as the following formula 3 to get pig's pollutant generation coefficient.

Pollutant generation coefficient of a pig = 1/3 coefficient of caring period + 2/3 coefficient of fattening period (3)

After the above processes, if there are several coefficients of the same livestock in the same province, we take the average value as the optimized coefficient.

3.2 Verification and correction

On the basis of optimized coefficients, using the existing coefficients of six major regions as references, we respectively calculate relative errors of each provincial coefficient by using formula 4. The result shows that 31 optimized coefficients' relative errors are higher than 20%. Therefore using formula 5, we further modify them to get the final daily pollutant generation coefficients of main livestock at provincial level in China.

$$\mu = \left(\hat{V}_{m,ij} - F_{m,i}\right)/F_{m,i} \tag{4}$$

$$G_{m,ij} = \hat{V}_{m,ij} + \left(\sum_{j=1}^{n_i} F_{m,i} - \sum_{j=1}^{n_i} \hat{V}_{m,ij}\right)/n_i, \quad |\mu| \geq 20\% \tag{5}$$

In formula 4, μ is relative error and $\hat{V}_{m,ij}$ is the average value of pollutant generation coefficients while $F_{m,i}$ is reference value of pollutant generation coefficients.

In formula 5, $G_{m,ij}$ is the corrected pollutant generation coefficients of each livestock and |μ| is absolute value of relative error. n_i is the number of provinces in the number i region, and i is the number of major region while j is the number of province in the major region.

4 Dataset composition

This dataset is comprised of six livestock' pollutant generation coefficients of each provinces in China. Six livestock are dairy cattle, beef, pig, broiler, laying hen and draft cattle. The spatial extent is 31 provinces except for Hong Kong, Macao and Taiwan in China.

Table 2 Pollutant generation coefficients of livestock at provincial level in China

Province (Municipality, Autonomous Region)	dairy cattle	beef	pig	broiler	laying hen	draft cattle
Beijing	42.393	24.432	4.288	0.107	0.16	25.345
Tianjin	48.013	25.369	3.85	0.12	0.165	25.345
Inner Mongolia	48.01	25.368	4.863	0.12	0.165	25.345
Hebei	42.02	21.555	3.215	0.12	0.165	25.345
Shanxi	42.02	21.555	3.215	0.12	0.165	25.345
Liaoning	45.15	22.623	4.665	0.14	0.133	25.285
Jilin	47.057	23.099	4.303	0.14	0.12	25.285
Heilongjiang	47.745	23.271	4.303	0.14	0.12	25.285
Shanghai	45.238	23.164	3.603	0.165	0.113	24.785
Jiangsu	46.478	23.474	3.547	0.197	0.123	24.785
Zhejiang	44.581	23	3.747	0.17	0.15	24.785
Anhui	42.475	22.474	2.77	0.22	0.113	24.785
Fujian	48.293	23.928	3.884	0.197	0.125	24.785
Shandong	41.467	22.222	2.77	0.22	0.125	24.785
Jiangxi	43.3	22.335	4.13	0.06	0.123	27.65
Henan	42.157	22.049	4.477	0.077	0.117	27.65
Hubei	51.267	26.218	4.093	0.06	0.12	27.65
Hunan	53.45	27.436	4.4	0.06	0.12	27.65
Guangdong	46.065	23.026	4.315	0.088	0.121	27.65
Guangxi	51.267	26.218	5.13	0.06	0.12	27.65
Hainan	46.9	23.235	3.49	0.06	0.12	27.65
Chongqing	44.983	23.897	5.135	0.06	0.12	24.785
Sichuan	48.317	26.119	4.803	0.06	0.12	24.785
Guizhou	51.238	27.455	5.063	0.06	0.12	24.785
Yunnan	53.793	29.052	3.947	0.067	0.13	24.785
Tibet	48.317	26.119	4.983	0.06	0.12	24.785
Gansu	39.247	23.348	5.03	0.18	0.095	22.335
Xinjiang	39.247	23.348	5.03	0.18	0.095	22.335
Shaanxi	42.723	23.22	5.098	0.153	0.113	22.335
Qinghai	39.247	23.348	5.03	0.18	0.095	22.335
Ningxia	36.935	22.963	5.098	0.17	0.103	22.335
Average	45.464	24.03	4.267	0.123	0.126	25.175

The detailed dataset is showed as Table 2.

5 Conclusion

The existing fixed coefficients at national or sub- region level are difficult to reflect spatial difference of pollutant production of each province and largely impact the precise of pollutant production. Thus, based on existing disperse coefficients published in various journals, after series of process of unit transformation, livestock and poultry equivalent normalization, and errors correction etc., we produce this dataset detailed in provincial level as described in this paper. This dataset can support more accurate national livestock pollutant production estimation and comparing research on livestock pollutant production at provincial level.

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