

Status Survey and Evaluation of Heavy Metal in Bazhong City

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Abstract. Based on the content of soil Cd, Pb and Zn, this paper conducted a comprehensive evaluation on the contamination status of heavy metal in Ba-zhong using Nemerow index and potential ecological risk index, meaning to provide scientific theoretical basis for the future prevention and treatment. The results showed that the average content of Zn was slightly higher than the background value of hilly area in Sichuan while the other two was under the standard line. However, differences do exist among various sampling places. The contents of Cd could come to 5.7 times than background value in some places at most. Nemerow index showed that the heavy metal pollution index of the soils of Ba-zhong was 1.0951 and closed to the clean state. Basically, Ba-zhong was at a low level of risk according to the potential ecological risk index.

1. Introduction

The rapid industrial development and urbanization accelerated the heavy metal pollution in the soil. Pollutants accumulate indirectly in the human body through the food chain and atmospheric sedimentation, which has become a sensitive issue of human health and safety [1-4]. Investigation and evaluation of the degree of soil heavy metal pollution in the area is to carry out soil remediation of contaminated plots, rational planning of land use patterns, the first prerequisite and necessary work to scientifically adjust the regional industrial structure. Based on the investigation of soil heavy metals in Bazhong, Sichuan Province, based on the investigation of the pollution degree of three heavy metals (Cd, Pb and Zn) in farmland soil in Bazhong [5]. Pollution levels, evaluate the three major heavy metal pollution levels of farmland soils in the study area, and provide a scientific basis for the prevention and control of farmland soil pollution and the adjustment of agricultural industrial structure in Bazhong.



2. Materials and methods

2.1. Soil sample collection

Bazhong is located in the northeastern Sichuan Basin, Dabashan at the southern foot of Micangshan, between longitude 106°20'~107°49' and latitude 31°15'~32°45'. The study area is dominated by middle and low mountain topography, with erosion, sedimentation, fan-shaped topography and gravitational accumulation, residual landform and so on. The parent rocks are dominated by red mudstone and sandy mudstone. The soil type is typical purple soil in Sichuan and Paddy soil. The area is subtropical monsoon climate zone, with an average annual temperature of 16.9°C, the average annual rainfall of 1150mm, the average light hours 1462.1h.

The sample time is from June 1, 2013 to August 1, 2013. Sampling Method According to the requirements of Multi-Target Geochemical Survey Regulation (1: 250000) (DD2005-1) issued by China Geological Survey, take sampling center as the center and select 20m as sampling radius for radial sampling (avoid fertilizer point and fertilizer residue Block, etc.), for each type of land use the same type of soil sampling set 4 to 5 repeated samples for a group of samples for each replicate of 20cm above the top soil mixed samples, each sampling point are using GPS positioning. Each group of samples to remove weeds, gravel and other debris, according to the quartering method, the same amount of each sample is mixed into a sample, each sample weight of not less than 1.5kg. A total of 344 soil samples were collected, including 48 in Bazhou, 81 in Nanjiang, 122 in Tongjiang and 91 in Pingchang. After the sample is dried, the soil is returned to its natural size by beating with a mallet and then sieved with a 20-mesh nylon sieve. The sample weighing not less than 300 g is selected by quartering (the weight of the sample not less than 600g), the sample will be processed into polyethylene plastic bottles.

Table 1. Descriptive statistics of SOM in soil samples.

indicator	Sample number	Max	Min	Average value	Standard error	Range
pH	44	8.38	7.47	8.12	0.18	7.47-8.38

2.2. Sample analysis

The sample test elements were Cd, Pb and Zn, which were analyzed by Chengdu Comprehensive Rock and Mineral Testing Center. Among them, Zn was analyzed by atomic fluorescence spectrometry, Cd was analyzed by flameless atomic absorption spectrometry, and Pb was analyzed by plasma photometry.

2.3. Soil heavy metal evaluation criteria

According to the Ministry of Agriculture "farmland soil environmental quality monitoring technical specifications NYT 395-2012" for statistical analysis and evaluation. Soil heavy metal pollution assessment using single pollution index method and integrated pollution index method.

Table 2. Nemerow index classification standard.

Rank	Integrated pollution index	Pollution level
1	$P \leq 0.7$	clear
2	$0.7 < P \leq 1.0$	Police cordon (still clean)
3	$1.0 < P \leq 2.0$	Light pollution
4	$2.0 < P \leq 3.0$	In pollution
5	$P > 3.0$	heavy pollution

3. Results and analysis

3.1. Soil heavy metal content

According to the results of three heavy metal contents analysis of farmland soil in four districts of Bazhong (Table 3), the content of Zn in farmland soil in Bazhong was higher than the background value, especially in Nanjiang County. 67 soil zinc Zn content is higher than the background value, the average content of excessive samples was 92.549, exceeding the background value of 30.7%; local farmland Cd content exceeded (up to 1.6mg kg⁻¹), exceeding the background value of 471.4%. Especially in Tongjiang County, the average content of Cd in 50 samples that exceeded the standard was 0.385 mg kg⁻¹, which exceeded the background value by 37.5%. Pb in the collected soil samples was not exceeded.

From the four districts and counties in Bazhong County farmland soil two kinds of heavy metals exceeded the level of view, Cd exceeded the level: Tongjiang > Bazhou District> Pingchang > Nanjiang; Zn exceeded: Nanjiang > Bazhou> Tongjiang > Pingchang.

Table 3. Contents of heavy metals in soil in Bazhong (mg·kg⁻¹)

Location	Samples	Cd			Pb			Zn		
		min	max	ave	min	max	ave	min	max	ave
Bazhou	48	0.128	0.384	0.275	18.8	33.2	24.325	41.9	111	77.040
Nancahng	83	0.097	0.617	0.267	9.47	56.4	25.517	24	174	86.301
Tongjiang	122	0.103	1.6	0.285	17.8	32.2	23.387	39.1	105	71.280
Pingchang	91	0.086	0.432	0.269	17.1	43.6	24.626	41.4	137	70.954
cite	344	0.086	1.6	0.275	9.471	56.4	24.360	24	174	75.622
range			0.28			25.10			70.80	

3.2. Farmland soil heavy metal pollution levels

Among the 344 monitoring samples in the city, there are 213 with an integrated pollution index greater than 1, of which 32 are in Bazhou, 64 in Nanjiang, 65 in Tongjiang and 49 in Pingchang. Among them, the pollution accounted for 1.2%, heavy pollution 0.29%, most of the farmland soil in a clean monk clean status. No pollution and heavy pollution occurred in Bazhou District and Pingchang County; only 2 of 83 monitoring sites in Nanjiang County belonged to pollution, accounting for 2.4%, no heavy pollution was found; a total of 122 spots were monitored in Tongjiang County, and two of them were polluted, Accounting for 1.6%, 1 was heavy pollution, accounting for 0.82%; a total of 91 were monitored and 49 were light pollution, accounting for 53.8%. Overall, most of the soil in Bazhong was clean and clean (warning line), But there are also some samples of heavy pollution level, which may be due to the sampling point in the factory or sewage pipe near.

According to the analysis of soil pollutant sharing rate (the ratio of a pollution index in the soil to the sum of pollution indexes), the order of the distribution rates of the three heavy metals in farmland soils is Zn (35.4%)> Cd (32.5%)> Pb (32.1%). The order of Bazhou area is: Zn (35.8%)> Cd (32.3%)> Pb (31.9%); the order of Nanjiang is Zn (38.2%)> Pb the order of Jiangxian is: Cd (34.4%)> Zn (34.1%)> Pb (31.5%). The order of Pingchang is: Zn (34.1%)> Pb (33.3%)> Cd (32.6%).

3.3. Farmland soil ecological risk assessment

Comparing the hazard index of three heavy metals, Cd> Pb> Zn, but all of them are at low risk level, which contributes little to the potential ecological pollution of soil heavy metals in the whole region. Among them, due to the large toxicity coefficient of Cd, the potentially harmful potential is also high, with 5 at medium risk level, accounting for 1.45% of the total; 2 at the heavier risk level, accounting for 0.58%; 1 at heavy Risk level, accounting for 0.29%.

Table 4. Potential ecological risk coefficient for every heavy metal in Bazhong city.

Elements	Min	Max	Mean	Location				
				$E_r^i < 40$	$40 \leq E_r^i < 80$	$80 \leq E_r^i < 160$	$160 \leq E_r^i < 320$	≥ 320
Cd	9.2	171.4	29.5	337	5	2	1	0
Pb	1.9	11.2	6.6	344	0	0	0	0
Zn	0.3	2.5	1.4	344	0	0	0	0

According to the calculation results, RI is the synergistic ecological risk of three kinds of heavy metal pollution per sample: the minimum potential ecological risk index of 344 soil samples is 15.94, the maximum value is 177.74, the average value is 35.38, Risk level. The potential ecological risk index of the area is graded and sampled as shown in Table 5, with four levels of low, severe, severe and severe. Only one of the samples was moderately risky, while the remaining 343 were low risk, accounting for 97.1% of the total. This shows that the risk level of soil potential in Bazhong is relatively low, with only one sample being at moderate risk level. Therefore, the potential risks of soils in Pakistan and China are generally in a safe state. However, it is also impossible to relax the monitoring of soil pollution in Bazhong and Prevention and treatment.

Table 5. Frequencies of potential ecological risk index in Bazhong city.

Ranges	$RI < 150$	$150 \leq RI < 300$	$300 \leq RI < 600$	$RI \geq 600$
Location	343	1	0	0
Size	97.1%	0.29%	0	0

4. Conclusion

1) According to the contents of three heavy metals in soils of Bazhong, the average contents of Pb and Cd are lower than the background value, but the contents of some samples are quite different. Although Zn content of most samples is higher than the background value, the average content only exceeds the background value by 6.78%. This shows that the general situation of farmland soil in Bazhong is better.

2) Based on the Nemerow index, although the comprehensive pollution index of Bazhong is above the warning line, it is extremely close to the warning line and basically in a clean condition. The overall situation of all districts and counties is the same as the basic situation of the whole city. The basic situation is still in a clean condition. Some Nemerow indexes of the samples have reached the level of heavy pollution or medium pollution. This may be related to the location of sampling points, Sewer pipes nearby. For example, Tongjiang County 58 to 60 samples, the elements are high (see Schedule 1), Nemerow index above the pollution level. However, overall, Bazhong is in a relatively safe position.

3) According to the potential ecological risk index method, the Pb and Zn elements in the soil of Bazhong City belong to the low-level risk. Cd has a moderate risk level due to the higher toxicity coefficient, two are in the higher risk level and one is heavy. Therefore, the potential ecological risk of Cd is relatively prominent, so relevant departments need to strengthen the regulation of Cd. Overall, according to the potential ecological risk index, Bazhong soil is at a low risk level.

4) Due to the large difference in the content of the elements between the samples, this shows that the pollution levels in different places are inconsistent. Therefore, appropriate measures should be taken in controlling soil pollution according to local conditions. In particular, the pollution in some areas should be given priority over other areas. On the one hand, it is necessary to control its sources of industrial pollution to prevent it from expanding the scope of pollution, the emergence of new pollution points. On the other hand, it is more appropriate to conduct targeted management of contaminated areas, especially to prevent new pollution during governance.

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