ISSN: 2688-8645

Progress in the Study of Sediment and Soil Heavy Metal Distribution Patterns in the Yangtze River Basin

Liheng Xia[1, 2, 3, 4, 5, *], Yanan Li[1, 2, 3, 4, 5]

[1]Shaanxi Provincial Land Engineering Construction Group Co., Ltd, Xi'an 710075, China

[2]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd, Xi'an, 710075, China

[3]Key Laboratory of Degraded and Unused Land Consolidation Engineering, Ministry of Natural Resources, , Xi'an, 710075, China

[4]Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an, 710075, China

[5]Land Engineering Technology Innovation Center, Ministry of Natural Resources, Xi'an, 710075, China

[*]18092729601@163.com

Abstract

The Yangtze River Basin is a vast area that connects the western, central and eastern parts of China. In the context of global change In the context of global changes, the industrialisation and urbanisation of the region is accelerating, and the resulting heavy metal pollution is becoming more and more of a concern. This paper analyses the current sedimentation of the Yangtze River basin. This paper analyses the current status of sediment and soil heavy metal pollution in the Yangtze River Basin, as well as the overall distribution pattern of sediment and soil heavy metals in the Yangtze River Basin, and the distribution of heavy metals in the Yangtze River Basin. In this paper, we analyse the current status of sediment and soil heavy metal pollution in the Yangtze River Basin, and the overall distribution pattern, distribution characteristics and sources of heavy metal pollution in the Yangtze River Basin. This paper discusses the migration patterns, the presence of heavy metals and the possible impact of global changes on the distribution of heavy metals in the Yangtze River basin. On this basis, this paper proposes that the current study of heavy metals in sediments and soils in the Yangtze River basin should be based on the following On this basis, this paper presents the shortcomings of the current research on heavy metals in sediments and soils in the Yangtze River basin, and provides an outlook on the future research work to be carried out.

Keywords

Sediment; Soil; Heavy metal pollution; Global change; The Yangtze River Basin.

1. Advances in Sediment Heavy Metal Research in the Yangtze River Basin

1.1. Current Status of Sediment Heavy Metal Research in the Yangtze River Basin

Studies have shown that sediments in aquatic ecosystems are both a source and a sink for heavy metals, which can accumulate in sediments through physical sorption, chemical precipitation and aquatic degradation, and that this accumulation can pose a risk to human health through the food chain [1]. On the other hand, because heavy metals are difficult to be degraded, pollution will increase over time if they are not treated and prevented (Feng et al., 2004); Wang

ISSN: 2688-8645

et al. (2014) collected sediments from the source to the estuary of the Yangtze River and found that heavy metal concentrations were generally lower in the upper reaches than in the middle and lower reaches, with high values occurring in areas rich in metal minerals, with developed industries and high population densities. [2] Guo et al. (2019) found that the initiation of large soil and water conservation and flood storage projects in the upper Yangtze River changed the hydrological characteristics and sediment environment of the middle and lower reaches of the Yangtze River, reducing sediment concentration and loading, increasing sediment grain size distribution, shifting from a slightly sedimentary to a highly erosive state in the mainstream river, and making tributaries a major source of marine sediment. [3] These factors have affected the aquatic ecosystem of the middle and lower reaches of the Yangtze River, redistributing heavy metal pollution in the environmental media and posing a potential threat to the aquatic environment of the basin.

1.2. Factors Affecting the Distribution of Heavy Metal Accumulation in Sediments of the Yangtze River Basin

Many factors such as climate change, natural disasters, mineral extraction and human activities can cause heavy metal enrichment and transport in the sediments of the Yangtze River basin. The transport of heavy metals in the sediments of the Yangtze River basin can be caused by many factors such as climate change, natural disasters, mining and human activities. The change in precipitation caused by climate change is an important factor in the accumulation and transport of heavy metals in sediments by changing sediment particles. It also affects the morphology of heavy metals and their bioeffective state [4].

The distance from the pollution source is also an important factor affecting the distribution. Lei et al. (2019) evaluated the content of heavy metals (Cu, Zn, Pb, Cd, Hg, As) in the surface sediments of the Yangtze River estuary from 2012 to 2016 and their spatial distribution characteristics. [5-7] The results showed that the concentrations of the six heavy metals were highest near the coast and lower as they moved further away from the coast. The results showed that the concentrations of the six heavy metals were highest near the coast and lower further away from the coast. Wang et al. Wang et al. (2020) demonstrated that short-term extreme hydrodynamic events caused by typhoons can affect or alter the distribution of heavy metals in surface sediments by altering sediment dynamics (i.e. resuspension, transport and partitioning) [8]. Luo et al. (2021) analysed the surface sediments of 62 lakes in the middle and lower reaches of the Yangtze River plain and found that they were affected by the presence of heavy metals in the mines and modern sediments located in the middle and southern reaches of the Yangtze River. (2021) analysed the surface sediments of 62 lakes in the middle and lower Yangtze River Plain and found that the lakes in the middle and southern reaches of the Yangtze River had high metal accumulation due to heavy pollution from mines and modern industries. [9-10] In addition In addition, the construction of flood control facilities in the upstream Three Gorges reservoir area and the construction of the downstream exploratory channel can influence lake sedimentation by controlling the hydrodynamic In addition, the construction of flood control facilities in the upstream Three Gorges reservoir and the downstream exploratory channel can influence the accumulation of heavy metals by controlling the hydrodynamic state of lake sedimentation [11-12]. Silty The heavy metal content is generally higher in silty areas.

2. Progress in the Study of Heavy Metals in Soils of the Yangtze River Basin

2.1. Status of Research on Heavy Metals in Soils of the Yangtze River Basin

With the rapid economic development of the Yangtze River basin, the development of agriculture and industry and the demand for mineral resources in the basin have become

ISSN: 2688-8645

increasingly prominent, increasing the test on the local soil environment. Waste rocks from mineral extraction in the Yangtze River Basin economic zone, through long-term weathering and erosion as well as rainfall showers, usually carry large amounts of heavy metal element emissions [13]. Human activities and lithological accumulation in the basin can also contribute to soil heavy metal pollution, with factors such as ongoing urbanisation and land use changes in the middle and lower reaches of the Yangtze contributing more to soil heavy metal pollution [14]. Heavy metal levels above reference values can cause contamination of riparian soils and indirectly have a detrimental effect on the richness and diversity of overlying vegetation communities [15], while industrial development and factory emissions in the surrounding area can also cause agricultural soil contamination, leading to contamination of food crops. Heavy metal contamination of soils in the Yangtze River Basin is closely related to the local natural environment and human health [16-17], and therefore Therefore, the accumulation of heavy metals in the soils of the Yangtze River Basin is of particular concern.

2.2. Factors Influencing the Distribution of Heavy Metal Accumulation in Yangtze River Basin Soils

Different soil types, different land use types and different economic structures can affect the accumulation and distribution of heavy metals in the soils of the Yangtze River basin. Yuan et al. (2021) found that Cd was the most polluting heavy metal in soils in China [18]. Cd is the most polluting heavy metal in China's soils, accounting for 33.54% and 44.65% of the pollution in farmland and urban soils respectively. Cd is the most polluting heavy metal in China's soils, accounting for 33.54% and 44.65% of pollution in agricultural and urban soils respectively. The average level of heavy metal pollution in urban soils is higher than that in agricultural soils, and the analysis results show that the level of heavy metal pollution in soils in the middle reaches of the Yangtze River and economically developed coastal areas is higher [19]. Zheng et al. (2016) found that in different land use types along Chongming Island in the lower reaches of the Yangtze River The mobility of heavy metals in soils of different land-use types also differed, with the mobility of heavy metals in the order of The mobility of heavy metals in soils of different land-use types also differs, with wetlands > drylands > paddy fields > forested lands in order of mobility, and the higher the mobility of heavy metals, the greater the threat to the surrounding environment. The higher the mobility of heavy metals, the greater the threat to the surrounding environment [20].

3. Sources of Heavy Metal Pollution in the Yangtze River Basin

Upper reaches: The upper reaches of the Yangtze River are less affected by human activities and are protected by national policies, and their pollution sources are mainly natural sources such as sediment sorting of different mineral elements in sediment source areas and natural weathering of rocks [21], and some industrial areas are mainly affected by anthropogenic sources [22].

Middle reaches: the middle reaches of the Yangtze River are characterised by rapid industrial and economic development and are heavily influenced by human activities, and their pollution sources are mainly anthropogenic. Researchers have studied heavy metals in sediments from the Wuhan section of the middle reaches of the Yangtze River and found that Cd is the most polluting heavy metal element in this section, in addition to Zn and Cu, which also accumulate to some extent, and they show higher biological effectiveness and can pose greater ecological risks, and urban sewage and industrial wastewater discharge have been identified as the main sources of pollution in this section [23].

The lower Yangtze estuary: as one of the most developed areas in China with very active land-sea interactions, its offshore sediments consist mainly of clayey silt and chalk [24] and are most susceptible to the effects of upstream surface runoff and coastal anthropogenic disturbances.

ISSN: 2688-8645

The heavy metals in the sediments come from chemical weathering, atmospheric deposition, terrestrial transport, inter-morphological transformations and human activities on the surrounding land, most notably from terrestrial transport and human activities [25].

4. Conclusion

Numerous scholars have already conducted studies and researches on heavy metals in the local area of the Yangtze River basin, fully reflecting the The Yangtze River basin has been studied and researched by many scholars, which fully reflects its prominent position in China. However, what are the sediment and soil contamination patterns and spatial and temporal distribution patterns for the whole Yangtze River main stream (dry and rich seasons)? However, what are the spatial and temporal distribution patterns of sediment and soil pollution in the whole Yangtze River main stream (during the dry and abundant seasons), and how will the distribution of sediment and soil heavy metals in the whole Yangtze River main stream It is still worthwhile to explore how the sediment and soil heavy metal distribution in the whole Yangtze River basin will respond to global changes [26-28].

References

[1] Cai L, Xu Z, Ren M, et al. 2012. Source identification of eight hazardous heavy metals in agricultural soils of Huizhou, Guangdong Province, China. Ecotoxicology and Environmental Safety, 78: 2-8.

[2] Chabukdhara M, Nema AK. 2013. Heavy metals assessment in urban soil around industrial clusters in Ghaziabad,India: Probabilistic health risk approach. Ecotoxicology and Environmental Safety, 87: 57-64.

[3] Chen Y, Li S, Zhang Y, et al. 2011. Assessing soil heavy metal pollution in the water-level-fluctuation zone of theThree Gorges Reservoir, China. Journal of Hazardous Materials, 191: 366-372.

[4] Liu P, Wu QM, Wang XK, et al. 2021. Spatiotemporal variation and sources of soil heavy metals along the lowerreaches of Yangtze River, China. Chemosphere, 10.1016/j.chemosphere.2021.132768.

[5] Shao D, Zhan Y, Zhou W, et al. 2016. Current status and temporal trend of heavy metals in farmland soil of theYangtze River delta region: Field survey and meta-analysis. Environmental Pollution, 219: 329-336.

[6] Zhong XL, Zhou SL, Zhu Q, et al. 2011. Fraction distribution and bioavailability of soil heavy metals in theYangtze River Delta: A case study of Kunshan City in Jiangsu Province, China. Journal of HazardousMaterials, 198: 13-21.

[7] Wan MX, Hu WY, Wang HF, et al. 2021. Comprehensive assessment of heavy metal risk in soil-crop systemsalong the Yangtze River in Nanjing, Southeast China. Science of the Total Environment, 780: 146567.

[8] Schipper AM, Lotterman K, Leuven R, et al. 2011. Plant communities in relation to flooding and soilcontamination in a lowland Rhine River floodplain. Environmental Pollution, 159: 182-189.

[9] Luo MK, Yu H, Liu Q, et al. 2021. Effect of river-lake connectivity on heavy metal diffusion and sourceidentification of heavy metals in the middle and lower reaches of the Yangtze River. Journal of HazardousMaterials, 416: 125818.

[10] Chen B, Liu J, Qie JD, et al. 2017. Spatio-temporal distribution and environmental risk of sedimentary heavy metals in the Yangtze River Estuary and its adjacent areas. Marine Pollution Bulletin, 116: 469-478.

[11] Bradl HB. 2004. Adsorption of heavy metal ions on soils and soils constituents. Journal of Colloid and Interface Science, 277: 1-18.

[12] Fang XH, Peng B, Wang X, et al. 2019. Distribution, contamination and source identification of heavy metals inbed sediments from the lower reaches of the Xiangjiang River in Hunan province, China. Science of the Total Environment, 689: 557-570.

ISSN: 2688-8645

[13] Han DM, Cheng JP, Hu XF, et al. 2017. Spatial distribution, risk assessment and source identification of heavy metals in sediments of the Yangtze River Estuary, China. Marine Pollution Bulletin, 115: 141-148.

[14] Kraemer S, Hering J. 2004. Biogeochemical controls on the mobility and bioavailability of metals in soils andgroundwater. Aquatic Sciences, 66: 1-2.

[15] Bing H, Zhou J, Wu Y, et al. 2016. Current state, sources, and potential risk of heavy metals in sediments of Three Gorges Reservoir, China. Environmental Pollution, 214: 485-496.

[16] Chen RS, De Sherbinbin A, Ye C. 2014. China's soil pollution: Farms on the frontline. Science, 344: 691.

[17] Feng H, Han X, Zhang W, et al. 2004. A preliminary study of heavy metal contamination in Yangtze River intertidal zone due to urbanization. Marine Pollution Bulletin, 49: 910-915.

[18] Jain CK. 2004. Metal fractionation study on bed sediments of River Yamuna, India. Water Research, 38: 569-578.Kabata-Pendias A, Pendias H. 1992. Trace Elements in Soils and Plants. London: CRC Press.

[19] Lin JG, Chen SY. 1998. The relationship between adsorption of heavy metal and organic matter in river sediments.Environment International, 24: 345-352.

[20] Zheng R, Zhao J, Zhou X, et al. 2016. Land use effects on the distribution and speciation of heavy metals andarsenic in coastal soils on Chongming island in the Yangtze River estuary, China. Pedosphere, 26: 74-84.

[21] Bertin C, Bourg ACM. 1995. Trends in the heavy metal content (Cd, Pb, Zn) of river sediments in the drainagebasin of smelting activities. Water Research, 29: 1729-1736.

[22] Cai Q, Long ML, Zhu M, et al. 2009. Food chain transfer of cadmium and lead to cattle in a lead-zinc smelter in Guizhou, China. Environmental Pollution, 157: 3078-3082.

[23] Chai X, Shimaoka T, Cao X, et al. 2007. Characteristics and mobility of heavy metals in an MSW landfill:Implications in risk assessment and reclamation. Journal of Hazardous Materials, 144: 485-491.

[24] Douben PET, Koeman JH. 1989. Effect of sediment on cadmium and lead in the stone loach (Noemacheilusbarbatulus L.). Aquatic Toxicology, 15: 253-268.

[25] Fan HM, Chen SS, Li ZE, et al. 2020. Assessment of heavy metals in water, sediment and shellfish organisms intypical areas of the Yangtze River Estuary, China. Marine Pollution Bulletin, 151: 110864.

[26] Forstner U. 1981. Metal Pollution in Aquatic Environment (Second Edition). Berlin: Springer-Verlag.

[27] Guo LC, Su N, Townend I, et al. 2019. From the headwater to the delta: A synthesis of the basin-scale sediment load regime in the Changjiang River. Earth Science Reviews, 197: 102900.

[28] Impellitteri CA, Saxe JK, Cochran M, et al. 2003. Predicting the bioavailability of copper and zinc in soils: Modeling the partitioning of potentially bioavailable copper and zinc from soil solid to soil solution.Environmental Toxicology and Chemistry, 22: 1380-1386.