

Research Progress and Prospect of Soil Environmental Criterion

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Abstract

Soil pollution not only poses a serious threat to eco-environmental quality, food safety and sustainable social and economic development. Through in-depth study of soil environmental quality background value, soil environmental capacity and soil ecological effect, the soil environmental quality benchmark is scientifically obtained. According to the research progress of soil environmental standards in developed countries, the research status of soil environmental standards in China is summarized, and the shortcomings of existing studies are put forward. soil should be associated with soil biosafety and ensuring soil ecological security. This will have important theoretical and practical significance for the prevention and control of soil pollution, strengthening soil environmental protection and pollution control, and promoting the sustainable development of agriculture.

Keywords

Soil environmental criteria, soil contamination, background value, eco cruelty, soil pollution.

1. Introduction

Soil is a natural resource with important environmental, economic and social functions [1] Is the material basis for human survival [2]. Soil Terminology [3] It is defined as an unconsolidated layer of land surface composed of minerals, organic matter, water, air and living things, which is fertile and capable of growing plants. Due to its physical and chemical properties, soil has certain adsorption, fixation, degradation and transformation effects on pollutants, and is an important regulator in the ecological environment. Soil environment is open, complex and changeable, with traces of human activities, and soil pollution caused by human activities has become a common form of pollution. Since the 1950s, China's industry and agriculture, especially heavy industry, have developed rapidly. A large number of pollutants, especially heavy metal pollutants, enter the soil environment through different channels, greatly damaging the soil function and causing serious deterioration of soil ecological environment quality. At present, China's arable land area polluted by heavy metals such as cadmium, arsenic and lead is nearly $2 \times 10^7 \text{hm}^2$ [4-5] In addition, it is estimated that the soil area polluted by pesticides and heavy metals in China has reached tens of millions of hectares, among which the contaminated soil in mining areas has reached 2 million hm^2 , oil contaminated soil about 5 million hm^2 , solid waste pollutes about 50,000 hm^2 of the soil [6].

Soil pollution not only poses a serious threat to China's ecological environment quality, food safety and sustainable social and economic development [6], and because of the soil pollution

has hidden or latent and irreversible and long-term [7], soil pollution is not only difficult to find, and once the pollution is difficult to recover, so the control of soil pollution has become a top priority. According to the data of the second national land survey conducted from July 2007 to December 2009, the existing cultivated land in China is 135.385 million HM2 [8] However, the first national soil pollution survey bulletin from April 2005 to December 2013 correspondingly showed that the overall soil point level in China exceeded 16.1% [9] In terms of land use types, the over-standard rate of cultivated land point was 19.4%, forest land 10.0% and grassland soil 10.4%.

Facing regional type complex, the pattern of economic development in our country is relatively extensive, unreasonable industrial structure and layout, pollutant total amount is high, the serious situation of soil pollution in some areas and through further study of soil environmental background value in quality and the ecological effect of soil environmental capacity and soil, scientific soil environmental quality benchmark, and based on this formulation corresponding soil environmental quality standards, and strive to solve the soil pollution caused by the fragile ecological environment, the prominent contradiction between human and land, soil desertification, salinization, soil erosion and a series of jarring contradictions between human and nature, It is of great theoretical and practical significance to prevent and control soil pollution, strengthen soil environmental protection and pollution control, and promote sustainable development of agriculture.

The concept and function of soil environmental quality benchmark

1.1. Reference Value of Soil Environmental Quality

Environmental benchmark refers to the maximum dose or concentration of pollutants in the environment that will not produce adverse or harmful effects on the specific protected objects (people or other organisms), or that will produce adverse or harmful effects on the specific protected objects if the dose or concentration exceeds this dose or concentration [10-17]. In other words, it means that when the content of a certain harmful substance in the environmental media such as atmosphere, water body, soil and sediment is a threshold value, no adverse or harmful effects will occur when people or organisms live in it; Or above this threshold, it has adverse or harmful effects on people or living things [18-20]. Environmental quality benchmark, referred to as environmental benchmark, refers to the maximum dose or concentration of pollutants in the environment that will not produce adverse or harmful effects on specific protected objects (people or other organisms). It is a multi-objective function or a range value based on different protected objects.

Soil environmental quality refers to the suitability of soil environmental factors for the survival and reproduction of human beings and terrestrial organisms. The characteristics of soil and its sustainable use mode play an important role in water, atmosphere, organisms, rocks and other environmental factors, especially in the suitability of human or other organisms for survival and social development [21]. Soil environmental quality is closely related to soil pollution degree, so the evaluation of soil environmental quality and soil pollution degree are the focus of current environmental research.

1.2. The Role of Soil Environmental Reference Value in the Construction of Soil Environmental Quality Standard System

Soil environmental quality standard and soil environmental standard are different concepts. Soil environmental quality benchmark studies the maximum dose or content of soil pollutants when their concentration has adverse or harmful effects on organisms and the environment. The soil environmental quality standard is based on the application function, protection target and main properties of soil, and specifies the maximum allowable concentration index value of pollutants in soil.

Soil environmental quality criterion is closely related to soil environmental standard. Soil environmental quality standard is the foundation of soil environmental quality standard. In the research on the formulation of soil environmental quality standards, the soil environmental quality benchmark should be studied first. Based on the obtained soil environmental quality benchmark value, the soil environmental quality benchmark value should be analyzed and formulated by comprehensively considering the factors such as sociality, regional economic development and technical level.

2. Research Progress Abroad

The soil screening value based on risk is the indicator value or warning value of pollutant concentration in soil, which is the basis for preliminary judgment and identification of environmental risk of contaminated soil. Due to ecological receptors (soil microbes, soil animals and plants) are numerous, and soil belong to high heterogeneous medium, so the establishment of the ecological risk benchmark relative to human health risk benchmark is more complex, at present, only a handful of countries to establish a ecological benchmark, and based on this established to protect the ecological safety of soil environmental quality standards. At present, more than 10 countries in the world have formulated or are in the process of establishing soil ecological screening benchmark values. The publication of these screening values promotes the development of ecological risk assessment technologies for contaminated soil and provides strong support for the environmental management of contaminated soil [22].

2.1. Screening Values and Formulation Methods of Ecological Soil in the United States

For the ecological risk assessment requirements of superfund sites, THE US EPA has developed the Eco-Soil Screening Value System (ECO-SSL). Eco-ssl is a set of soil pollutant concentration screening values based on ecological environmental protection. The protection targets are ecological receptors that contact with soil or feed on biomass in soil [23]. Eco-ssl not only gives the general filter value, but also gives the derivation method of the filter value. The filter value is formulated with conservative assumption, which is used for the initial screening of ecological risks of the site [24-25].

2.2. Soil Ecological Survey Values and Development Strategies in Australia

There are several types of soil quality Guidelines (SQG) depending on their objectives. The National Environment Protection Measure (NEPM) of Australia contains soil quality guidance value based on ecological risk, namely, soil investigation Level (EIL), which is used to guide The assessment of contaminated sites in Australia [25-28]. When the soil pollutant content exceeds the soil ecological survey value, it indicates that the terrestrial ecosystem may suffer adverse effects. The soil ecological survey values can be used to indicate whether the site requires further investigation.

2.3. UK Soil Screening Values and Formulation Methods

Soil Screening values are a group of concentrations of chemicals in the soil. When the concentration of chemical substances in soil is lower than this concentration, it is considered that there is no adverse effect on the function of soil wildlife, plants and microorganisms. If the pollutant concentration exceeds the soil screening value, a higher level of investigation and assessment should be conducted to determine whether there is an ecological risk [29-32]. When soil may have both ecological and human health risks, soil screening values (SSVs) and soil guidance values (SGVs) can be used for simultaneous screening. SGVs are soil screening values based on human health risks.

The FORMULATION of SSV in the UK is mainly based on the European Commission Technical Guidance Document (TGD) to obtain PNEC_{soil}(Predicted No Effect Concentration for soil), mainly including data acquisition, data selection, data normalization, data extrapolation, SSV value determination, etc [33-34].

3. Overview of Soil Environmental Quality Standard System Development in China

China is a large agricultural country, soil is the basis of agricultural production, strengthen soil protection to accelerate the modernization of agriculture has a very important practical significance. However, in the past few decades, with the acceleration of industrialization, the disorderly and excessive discharge of waste gas, waste water, solid waste and other industrial wastes has led to the aggravation of soil pollution, the destruction of soil resources, and the decline of soil quality. In order to protect non-renewable soil resources and maintain the red line of agricultural production, the State Environmental Protection Administration and the Chinese Academy of Sciences issued China's "Soil Environmental Quality Standard" in 1995, which stipulated the maximum allowable concentration index value of pollutants in soil and the corresponding monitoring methods. The standard according to the function of soil and the target of protection, the soil environmental quality is divided into three categories: the soil I class level standard, to protect areas of natural ecology, maintain the natural background of the limit of soil environmental quality. It is mainly applicable to nature reserves stipulated by the state (except for those with high heavy metal content in original background), centralized drinking water sources, tea gardens, pastures and soil in other reserves, and the soil quality basically maintains the level of natural background. II class soil secondary standard, to protect agricultural production, the limit of maintenance human body health. It is mainly applicable to general farmland, vegetable fields, tea gardens, orchards, pastures and other soils. The soil quality is basically maintained at a level that does not cause harm or pollution to plants and the environment. III class soil executive level 3 standards, to ensure normal production and plant growth of agriculture and forestry of the critical value of the soil. It is mainly applied to forested soil, high background soil with large pollutant capacity and farmland soil near mineral resources. The first level of the standard adopts geochemical method, which is mainly based on the soil background value in China. The second standard adopts ecological environmental effect method, which is mainly based on whether harmful substances in soil cause harm and effect to plants and the environment. The third level standard is also formulated by the method of ecological environmental effect, based on the data of plants and environment that have not been harmed or polluted by soil in some high content areas in China [22].

In June and October 2014, the Ministry of Environmental Protection held a special meeting on soil Environmental Quality Standards, in which it was clearly suggested that the revised Soil Environmental Quality Standards continue to take the soil environmental quality of agricultural land as the evaluation object, and constitute a soil environmental quality evaluation standard system together with the soil environmental risk assessment standards for construction land. The national unified natural background value of soil environment is no longer required. On June 28, 2018, the Ministry of Ecology and Environment and the State Administration for Market Regulation jointly issued the Standards for Soil Environmental Quality and Risk Control of Soil Pollution in Agricultural Land (Trial) (GB 15618-2018). The new standard clarifies the particularity of soil environmental quality standards different from atmospheric and water environmental quality standards. First, soil properties are greatly different in different regions, and soil environmental quality assessment in different regions cannot be "one-size-fits-all". Second, the harmful consequences of soil pollution are affected by soil utilization, soil properties, receptor types and exposure pathways. Soil environmental

quality evaluation of the above factors should be considered, should distinguish between protection object, the case such as environmental activity and exposure ways were considered contaminants limit or pollution risk assessment technology principle, method and filter value: one is partition standard for soil environmental background, adjust the perfecting the farmland soil environment quality standard; Second, on the basis of the published HJ 25 series standards, further supplement and improve, and formulate the guidance value for the screening of soil pollutants' health risks in construction land; Third, local people's governments at the provincial level, where conditions permit, may also formulate local standards in accordance with these standards.

4. There Are Problems in Soil Environmental Quality Standard System in China

The State Environmental Protection Administration issued and implemented the Soil Environmental Quality Standard in March 1996. The standard reflects the achievements of China's soil scientific research over the years. The standard provides local laws to evaluate soil environmental quality, judge whether soil environmental pollution is polluted or not, and predict the development trend of soil environmental quality, etc., and effectively promotes the management, protection and supervision of soil resources [23]. But along with the scientific and harmonious development of economy and society, and state the soil environmental quality standards and the current soil environment quality request does not adapt, not coordinated, mainly: the nature of the soil around the difference is very big, in a unified national standard critical concentration will result in some regions around the evaluation results and the actual situation in and out; Too few contaminant items in the standards; The standard values of organic pollutants and lead are higher. Specific features are as follows:

1) The standard has the problem of "one size fits all", a scale to measure. China has a large geographical span, and soil properties vary greatly from region to region. Background content is generally related to regional geological background, soil formation, and superimposed intensity of anthropogenic pollution [24]. In addition, the migration and transformation of the same pollutant into soil and the adsorption, replacement and combination of the same pollutant with soil components are extremely complex, and the content of the same element in soil in different regions is also quite different. And the current level of the soil environment quality standard standard adopted the background value of national unity, will appear in the practical application in some areas although not the accumulation of heavy metals, but due to the national standard is lower than its own soil background value, and is thought to do not conform to the requirements of the type of land use, and some existing pollutants total region, due to the national standard is higher than its background value, and not cause pollution.

2) The standard is inconsistent with or even deviates from the practical operation and actual evaluation. Countries the soil environmental quality standards, secondary standards are on the same pollutants to choose the smallest soil environment by comprehensive consideration of the critical value content, therefore, most of the local use of this standard to calculate the soil environmental capacity is small, cause in the soil environment management and pollution control can not make full use of the self-purification capacity of the soil. In the actual evaluation of soil environmental quality, if the content of pollutants evaluated is lower than the second-level national standard value, the soil is not polluted. If the assessed pollutant content is higher than the second-level standard value, it is difficult to determine whether the soil is contaminated or not due to the different soil background values in different regions [25-26].

Based on the above review, China has a vast territory. From south to north and west to east, there are not only huge differences in geological and geomorphic conditions, but also differences in human farming history, land use mode, industrial and agricultural development,

and economic level in different regions, resulting in extremely obvious differences in the nature of different soil types in different regions. The application of the national unified soil environmental quality standard in the regions with different soil background values is obviously difficult to meet the needs of soil environmental quality assessment in different regions, so it is imperative to formulate local standards. At the same time, domestic research on the background and benchmark of heavy metals in new cultivated land soil is less, and there is no perfect ecological regional standard system. It is of great significance to formulate soil environmental background standards in different regions, adjust and improve soil environmental quality standards for agricultural land, and further construct environmental quality standard system for heavy metals of typical soil types in Shaanxi Province.

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