

## Article

# Legal System of Soil Pollution Remediation in China and Its Regulation and Guidance to Soil Pollution Remediation

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**Abstract:** Faced with increasingly serious soil pollution problems, China has passed the Chinese Soil Pollution Prevention and Control Law (hereinafter referred to as the Law on the Prevention and Control of Soil Pollution) and established a series of soil pollution remediation systems. However, there are still some shortcomings in the current legal system for soil pollution remediation, which cannot fully solve the problems faced in soil remediation activities. The research focuses on the legal system for soil pollution remediation. This study analyzes the development process of relevant systems, focusing on the analysis of the Soil Pollution Prevention and Control Law, including the basic content and process of soil pollution prevention and control work. On this basis, this study summarizes the legal structure and practice of soil pollution control in China and analyzes the problems existing in the implementation of China's soil pollution remediation legal system, such as imperfect remediation standards and insufficient public participation. Then, the relevant policies of EU countries are summarized and analyzed. Combined with the actual situation of China, suggestions are put forward to improve the legal system of soil pollution remediation in China and strengthen soil remediation.

**Keywords:** soil pollution; pollution remediation; legal system; remediation funds; responsible person; improvement



**Citation:** Liu, Z.; Yin, Y.; Zhang, Y.; Shi, S. Legal System of Soil Pollution Remediation in China and Its Regulation and Guidance to Soil Pollution Remediation. *Sustainability* **2023**, *15*, 11504. <https://doi.org/10.3390/su151511504>

Academic Editors: Junyuan Guo and Fei Li

Received: 15 May 2023

Revised: 11 July 2023

Accepted: 13 July 2023

Published: 25 July 2023



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## 1. Introduction

Environmental protection includes the protection of ecosystems, natural organisms, and non-living resources such as air, water, and soil and their interactions [1]. Currently, almost all modern countries are facing various environmental problems, including global warming, soil erosion, desertification, and other issues. It brings huge challenges to human survival [2]. Soil pollution is a common concern around the world because soil is the main resource for food production, supporting the rise and security of every country. In addition, soil pollution may lead to various types of pollution such as groundwater and air pollution, which has negative impacts on human health and food safety [3]. China is responsible for one-seventh of the world's population, and soil safety is particularly important. In the past few decades, the rapid economic development has caused people to overlook the protection of land. Today, China's soil pollution problem has become quite serious [4]. Although the Chinese government has implemented a number of laws and regulations aimed at protecting the environment since 2000, most of them concentrate on air and water pollution and pay little attention to soil degradation [5]. The Chinese government started to pay attention to the increasingly critical issue of land pollution in 2016, when the State Council of China released the "Action Plan for Prevention and Control of Soil Pollution". With the official adoption of the "Soil Pollution Prevention and Control Law" in 2019, China's efforts to avoid soil pollution and restore degraded areas

have moved into a new phase. Meanwhile, after the 1970s, countries around the world began to formulate laws to protect uncontaminated soil and repair contaminated soil. EU member states introduced relevant policies based on their own situations. EU countries represented by Austria not only consider soil pollution when formulating soil pollution remediation plans but also develop a systematic plan that includes urban construction, ecological environment protection, and soil and water conservation. In terms of identifying the responsible parties, Germany's system is undoubtedly the best among EU countries. In addition to expanding the scope of the responsible person, a system of limited traceability of past responsibilities has also been adopted. Italy and Estonia have strictly formulated standards for soil pollution remediation and risk supervision, which plays a guiding role in the remediation process and the goals that remediation attempts to achieve. The goal of the study is to clarify the development process and key components of China's soil pollution remediation legislative and regulatory system as well as to confirm the system's positive influence on soil pollution control. Finally, according to the issues existing in the practice process, some suggestions are put forward by referring to the relevant policies of EU countries.

## 2. The Development of Soil Pollution Cleanup Laws and Regulations in China

The occurrence of soil pollution can be generally divided into two pathways, namely human pollution and natural pollution. Human pollution often plays a more important role. The pollution status of soil can be determined by the soil environmental quality standards. The residual accumulation of pollutants in soil can cause obstacles to crop growth. Over-accumulation in grains or edible parts (not exceeding food hygiene standards) affects the environmental quality of soil and water. The soil environmental quality standard is the maximum allowable content of pollutants in soil. To implement "the Environmental Protection of the China", prevent soil pollution and protect the ecological environment, and ensure agricultural and forestry production, the national standard of "the National Standards of the People's Republic of China for soil environmental quality" was formulated. This standard specifies the maximum allowable concentration index values of pollutants in soil and the corresponding monitoring methods based on soil application functions, protection objectives, and main soil properties. This standard belongs to the agricultural soil fertilizer standard, which applies to soil in farmland, vegetable fields, tea gardens, orchards, pastures, forests, nature reserves, etc. The standard category is GB—National Standard.

Among them, the soil monitoring methods refer to the relevant chapters of "Environmental Monitoring Analysis Methods" and "Modern Analysis Methods of Soil Elements" (compiled by the China Environmental Monitoring Station) of the National Environmental Protection Bureau. After the relevant national method standards are issued, they shall be implemented in accordance with the national standards. The main sources of soil pollution are the following: industrial "three wastes" emissions, whose pollution pathways can be divided into six main types. (1) Gaseous pollution first pollutes the atmosphere and then settles to the surface with rain to pollute the soil. Gaseous pollution also includes the pollution of soil caused by car exhaust. (2) Waterborne pollution refers to the pollution of soil by irrigating farmland after industrial wastewater is discharged. (3) Waste residue pollution mainly refers to the infiltration of water-soluble toxic substances into the soil by rainwater, which in turn pollutes surface or groundwater. (4) Regarding pesticide application, to prevent and control soil pests, pathogens, and weeds, pesticides are directly applied to the soil or sprayed onto the ground. (5) Radioactive contamination comes from the fallout after nuclear explosion and various discharges generated during the production and utilization of radioactive substances. (6) Biological waste comes from human and animal feces, garbage, domestic sewage, hospital sewage, and some industrial wastewater (such as tannery sewage and slaughterhouse sewage) and contains a large amount of organic matter and microorganisms. Soil pollution is mainly caused by sewage irrigation or fertilization with untreated feces. Soil pollution load refers to the product of the concentration of

pollution factors in soil pollutants and the daily emission of pollutants. The load of soil pollution can be regulated by the self-purification ability of the soil, but due to the increase of human activities, the self-purification ability of the soil can no longer solve the problem of the soil pollution load. Thus, it is required to use human measures for soil remediation. Soil remediation is a technical measure to restore the normal function of contaminated soil and is currently mainly implemented through legal supervision.

The legislative process of China's soil pollution remediation can be roughly divided into two stages, with the "Soil Pollution Prevention and Control Plan" promulgated by the State Council in 2016 as the dividing line. Before 2016, soil contamination prevention and cleanup laws were not entirely effective. Land preservation laws and regulations could date back to 2000. At this time, the system of laws and regulations was non-compulsory and fragmented. Many laws and regulations were not for soil pollution remediation but only referred to relevant content [6,7]. The details are shown in Table 1.

**Table 1.** Relevant laws and regulations before 2016 (partial).

Implementation Time	Promulgating Authority	Law and Regulation Name	Nature	Main Content
1999	The State Council of China	"Regulations on the Protection of Basic Farmland"	Administrative regulations	The parties have the obligation to deal with and report the farmland pollution.
2004	Standing Committee of the National People's Congress	"Land Administration Law"	Law	Local governments have the obligation to monitor and remediate land pollution.
2008	Ministry of Environmental Protection	"Opinions on Strengthening the Prevention and Control of Soil Pollution"	Important documents	Identify areas with severe agricultural and industrial pollution and establish a soil environmental monitoring network.
2012	Ministry of Environmental Protection and Ministry of Land and Resources	"Notice on Ensuring Environmental Safety in the Redevelopment and Utilization of Industrial Enterprise Land"	Important documents	Carry out environmental risk assessment and treatment and restoration and determine the responsibility determination principle of "Whoever pollutes shall be responsible".
2015	Standing Committee of the National People's Congress	"Environmental Protection Law of the People's Republic of China" (revised)	Law	The state should carry out environmental monitoring and strengthen environmental restoration. Local governments should provide financial support for environmental restoration. Local governments have supervisory responsibilities in the process of environmental protection.

It is evident that until 2016, local governments and affiliated departments were the major targets of legislation and regulations. Not only was the responsibility subject single, but many descriptions were also vague and non-mandatory. Although subsequent laws and regulations have paid more attention to soil pollution, there were no relevant supporting measures, making it difficult to implement them. The Soil Environmental Quality Risk Control Standard for Soil Contamination of Agricultural Land and Soil Environmental Quality Risk Control Standard for Soil Contamination of Development Land were published by

the Ministry of Ecology and Environment in 2018. From 2016 to 2019, several provinces issued local legislation to support soil pollution prevention and control. These regionally distinct municipal laws and ordinances were applicable to the practical concerns of the neighborhood. In 2019, the Law on the Prevention and Control of Soil Pollution was officially implemented. The Criteria for Evaluation of Effects of Cultivated Land Pollution Control and Criteria for Treatment and Restoration of Contaminated Cultivated Land were subsequently published by the Ministry of Agriculture and Rural Affairs. The Technical Guidelines for Soil Remediation of Construction Land were published by the Ministry of Ecology and Environment. Now, Chinese soil contamination cleanup regulations are at the preliminary stages. The “Administrative Measures for Soil Pollution Prevention and Control Funds”, which established specialized funds for soil pollution prevention and restoration projects, was jointly promulgated in 2020 by six agencies, including the Ministry of Finance. In 2021, the Ministry of Ecology and Environment issued the “Interim Measures for Identifying Persons Responsible for Agricultural Land Soil Pollution” and “Interim Measures for Identifying Persons Responsible for Soil on Construction Land”, which clarified the identification procedures of responsible parties. Thus far, the preliminary construction of China’s regulations and systems for preventing and controlling soil pollution has been completed.

### 3. The Primary Components of China’s Soil Pollution Remediation Laws

The Soil Pollution Prevention and Control Law went into force in China on 1 January 2019. The central and local governments in China have issued a series of supporting laws and regulations to create a legal framework for soil pollution control, with the Soil Pollution Prevention and Control Law as the core. The whole system has made a qualitative leap in both legislative concept and system design, significantly improving the efficiency and quality of China’s soil pollution remediation work [8].

#### 3.1. The Basic System of the Legal System on Soil Pollution Remediation in China

The Soil Pollution Prevention and Control Law established basic systems from six perspectives: administration, standards, monitoring, investigation, evaluation, and information disclosure, as shown in Table 2.

**Table 2.** Basic System of the Law on Soil Pollution Prevention and Control.

Basic System	Details
Administrative system	Local governments are responsible for the prevention and safe utilization of soil pollution within the administrative area;
	Local governments have supervisory and management responsibilities within their purview;
	Set corresponding assessment targets for governments above the county level.
Pollution standards formulation	The state council formulates national soil pollution risk management and control standards;
	Allow provincial governments to develop realistic local representations following national standards;
	Regularly evaluate the implementation of standards and make appropriate corrections based on the results.
Monitoring system	The monitoring norms are led by the competent department of ecological environment, and other relevant departments can make suggestions;
	The monitoring sites are set up by national, unified planning;
	Local governments need to focus on monitoring plots that meet certain conditions.

Table 2. Cont.

Basic System	Details
Investigation system	Establish a survey advisory group by experts and technicians and formulate a nationwide soil pollution survey plan;
	Strictly follow the relevant regulations during the investigation process and form an investigation report;
	Allow local governments to carry out detailed surveys of soil pollution based on the actual situation in the administrative area, focusing on land parcels whose use has changed.
Evaluation system	Control and repair the plots that exceed the indicators stipulated by law and monitor the plots that do not exceed the standards;
	Assess the results of soil pollution remediation, and whether it meets expectations or not, a written report should be formed.
Information disclosure	Local governments must establish a soil environment information sharing platform to disclose relevant information including dynamic data on soil pollution, changes in laws and regulations, and punishment reports to the public in accordance with the law.

According to the basic system in Table 2, the “Soil Pollution Prevention and Control Law” also stipulates the general procedures that need to be followed when carrying out soil pollution prevention and control work. The first step is to determine the pollution situation of the plot through preliminary investigation and monitoring. After the risk assessment, the recovery plan is formulated. The last step is to evaluate the repair effect according to the evaluation report and conduct postmanagement. The specific process is shown in Figure 1.

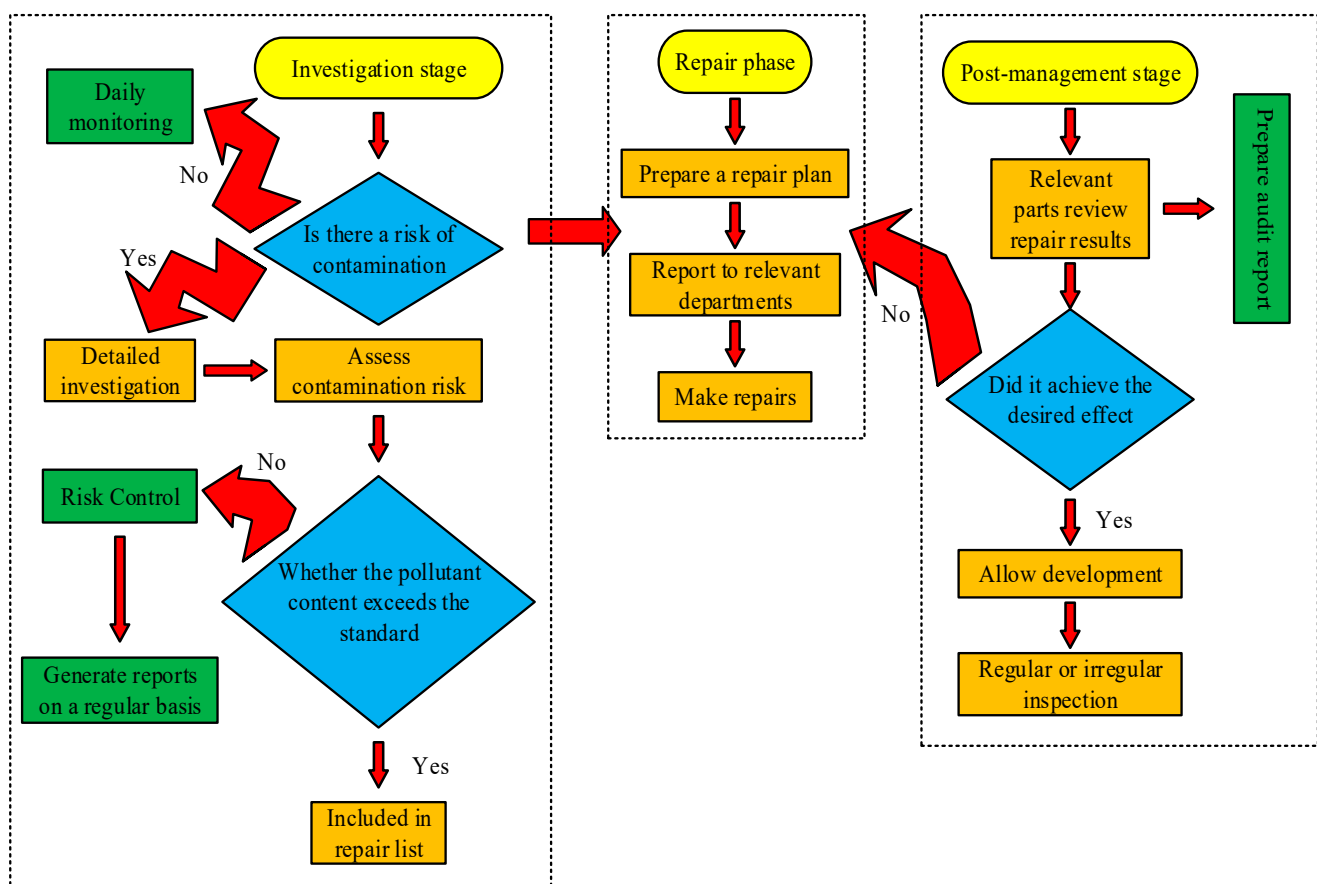


Figure 1. The specific process of soil control and restoration.

In Figure 1, the entire prevention and restoration process must comply with the restoration principles proposed in the “Soil Pollution Prevention and Control Law”, that is, adjust measures scientifically and reasonably according to local conditions, improve pertinence and effectiveness, and avoid secondary pollution in the restoration process. Relevant reports, plans, and records need to be disclosed according to law.

### 3.2. Other Systems in the Legal System on Soil Pollution Remediation in China

The “Soil Pollution Prevention and Control Law” stipulates that the person responsible for pollution shall be determined according to the principle that whoever pollutes shall be responsible. The actual polluters are responsible for the remediation and follow-up management of the polluted plots. When the actual polluter cannot be identified, the land-uses-rights holder will carry out the restoration project. Local governments can carry out restoration projects on polluted plots according to the actual situation. The “Soil Pollution Prevention and Control Law” breaks the drawbacks of the single responsible person in previous laws and regulations, making the division of responsibilities clearer [9]. According to the different degree of pollution, the polluted plots are distinguished, and different management measures are stipulated. For plots with higher and plots with lower pollution risks, different corresponding management measures will be implemented. Remediation works are performed on already-contaminated plots. Local governments should carry out risk management and control of construction land and formulate risk management and restoration catalogs. Land plots included in the catalog are prohibited from use. Combined with regional planning, the seriously polluted land in the catalogue is repaired. The repaired plots should be removed from the directory in time. The evaluation of groundwater quality should be included in the pollution risk assessment of the plot. For the plots that need to be rehabilitated, the part that solves groundwater pollution ought to be included. The central and local governments should set up funds dedicated to soil pollution prevention and remediation to cope with the increasing demand for funds. Local governments have the power of supervision and administrative coercion over soil pollution behavior and encourage the public or the media to supervise soil pollution behavior. The Measures for the Management of Soil Pollution Prevention Fund is a document issued by the Ministry of Finance, the Ministry of Ecological Environment, the Ministry of Agriculture and Rural Affairs, the Ministry of Natural Resources, the Ministry of Housing and Urban Rural Development, and the National Forestry and Grassland Administration in 2020. The provincial finance department, in conjunction with ecological and environmental departments, formulated a fund establishment plan based on actual work, clarifying the fund management mode, governance structure, and determination method of fund management institutions. To standardize the identification of the person responsible for soil pollution of construction land, in accordance with the Environmental Protection Law of the China, the Law of the China on the Prevention and Control of Soil Pollution, and other relevant laws, the Ministry of Ecological Environment, together with the Ministry of Natural Resources, formulated the Interim Measures for the Identification of the Person Responsible for Soil Pollution of Construction Land, which was officially released in January 2021. The method is applicable to the identification of soil pollution responsible persons for agricultural land when the agricultural and rural areas, forestry, and grass authorities, in conjunction with the ecological environment and natural resources authorities, exercise their supervisory and management responsibilities in accordance with the law.

## 4. The Legal Structure in China That Governs Soil Pollution Cleanup and the Practice of Soil Pollution Control

A national soil contamination assessment was started by the Chinese government in 2017. Because of this action, numerous businesses dedicated to the prevention and remediation of soil pollution were founded. The capital market’s investments took the position of the government’s as the primary driving force. The desire and behavior of



pertinent responsible parties to carry out soil pollution prevention and restoration have grown more significant after 2019, with the improvement of the legal and regulatory system, especially the clarification of the responsible-person identification system [10].

#### 4.1. The Supervising Role of China's Soil Pollution Remediation Legal System on Responsible Subjects

According to the theory of planned behavior, the core of encouraging polluters to clean up soil pollution is to inculcate the concept of environmental protection, which believes that the basis of implementing behavior is subjective will [11]. Although numerous circumstances interfere with the degree of transformation, it is rare for the subjective will of the polluter to be totally turned into conduct that reduces pollution. Before the “Soil Pollution Prevention and Control Law”, actual polluters and owners of land-use rights shoulder fewer responsibilities than administrative subjects. The willingness of those who take the initiative to remediate soil pollution is not very high [12]. This is because the government or relevant departments are the primary bodies responsible for relevant laws and regulations. The “Soil Pollution Prevention and Control Law” can successfully encourage risk control and restoration willingness, according to a survey of 1000 land-use rights holders who might have soil pollution behaviors. Indicators for soil pollution prevention and restoration behavior include attitude, subjective will, objective will, moral restraints, legal restraints, and social restraints, as illustrated in Table 3.

**Table 3.** Soil Pollution Remediation Willingness Index.

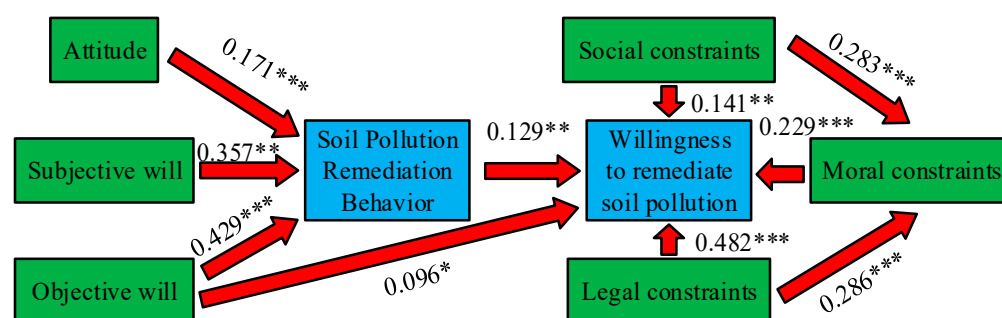
Variable Name	Measurement Topic
Attitude (att)	Considers it essential to avoid and regulate soil pollution(att1) Supports preventing and reducing soil pollution (att2) Actively participates in soil pollution prevention and control (att3)
Subjective will (sw)	Thinks it is easy to carry out soil pollution prevention and remediation (sw1) Able to bear the cost of soil pollution remediation and prevention (sw2)
Objective will (ow)	Relatives or friends want to carry out soil pollution prevention and control (ow1) Stakeholders desire to stop and manage soil pollution (ow2) Social groups want to stop and manage soil pollution (ow3)
Moral constraints (mc)	Regarded as having the duty and responsibility to prevent and control soil pollution (mc1) Feels guilty about soil pollution (mc2)
Legal constraints (lc)	Approval of the “Soil pollution prevention and control law” (lc1) Complies with local laws and regulations (lc2)
Social constraints (sc)	Relatives and friends are implementing soil pollution remediation projects (sc1) Stakeholders are implementing soil contamination remediation projects (sc2)

In this study, a total of 1000 questionnaires were distributed. In total, 872 of those were recovered as legitimate, for an efficiency rate of 87.2%. Since soil pollution prevention and control behavior are a latent variable measured by multiple observed variables, reliability and validity tests were required. The results are shown in Table 4.

In Table 4, the Cronbach reliability coefficients of all variables are above 0.80, indicating that the data can pass the reliability test, and the questionnaire results have good reliability. The factor loading of each variable is between 0.50 and 0.90. The mean variance extraction is greater than the square of the correlation coefficient, indicating that the data can pass the validity test, and the questionnaire results have good validity. Hierarchical regression test variables are used to detect the regulating effect of soil pollution prevention intention and soil pollution prevention behavior [13,14]. The result is shown in Figure 2.

**Table 4.** Results of confirmatory factor analysis and reliability test.

Variable Name	Measurement Standard	Factor Loadings	Mean Variance Extraction	Cronbach's Alpha Coefficient
Attitude	Attitude1	0.641	0.591	0.802
	Attitude2	0.792		
	Attitude3	0.785		
Subjective will	Subjective will1	0.803	0.602	0.803
	Subjective will2	0.834		
Objective will	Objective will1	0.692	0.614	0.817
	Objective will2	0.714		
	Objective will3	0.716		
Moral constraints	Moral constraints1	0.826	0.583	0.809
	Moral constraints2	0.728		
Legal constraints	Legal constraints1	0.724	0.591	0.822
	Legal constraints2	0.807		
Social constraints	Social constraints1	0.823	0.619	0.813
	Social constraints2	0.855		

**Figure 2.** Moderation effect test results. Note: \*\*\*, \*\*, \* respectively represent significance levels of 1%, 5%, and 10%.

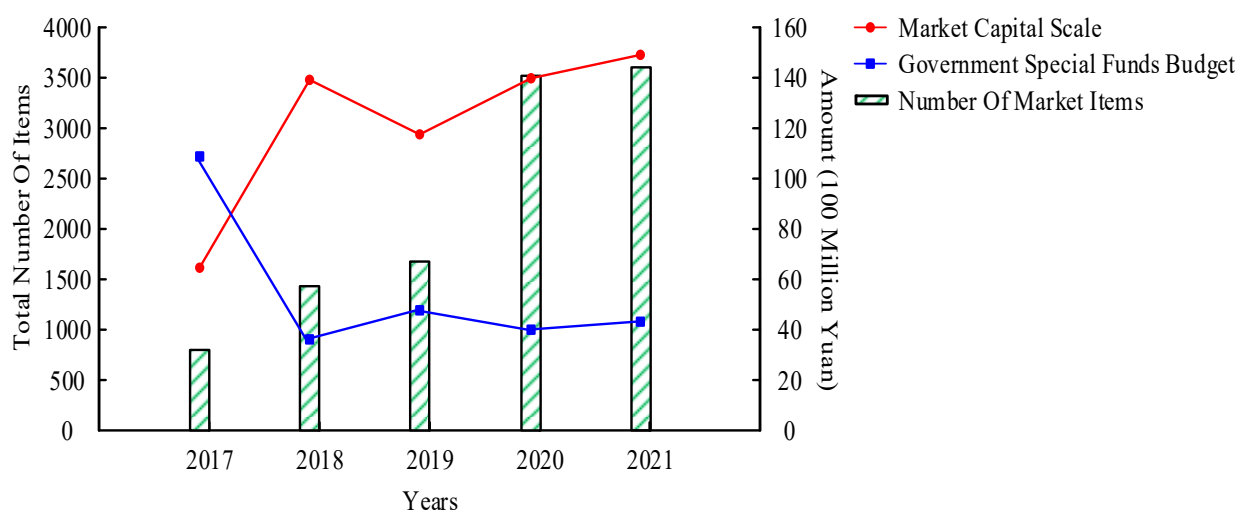
From Figure 2, both the direct and indirect effects of subjective will and objective will on soil pollution remediation intention and soil pollution remediation behavior pass the significance test. The direct effects of both are greater than the attitude variable.

The direct effect of legal norms on soil pollution remediation behavior is significantly greater than social norms and moral norms. Legal norms and social norms can have a direct effect on moral norms. It is evident that individuals who pollute and owners of land-use rights benefit greatly from the implementation of the “Soil Pollution Prevention and Control Law”.

#### 4.2. After China’s Soil Contamination Remediation Legal System Was Established, Cleanup Successes

Since China decided to formulate a legal system for soil pollution remediation in 2016, the soil pollution remediation industry has begun to rise. The government has also invested a great deal of money into preliminary investigations and preparations [15]. Figure 3 illustrates the specific investment situation. Among them, the data on the investment of restoration funds and the number of restoration projects are sourced from the list of central soil pollution prevention and control funds planned to support projects published by the ecological environment bureaus of each province and city, which were added to obtain the list. The list of central soil pollution prevention and control funds planned to support projects published by the ecological environment bureaus of each province and city was also obtained according to the guidelines for the storage of central ecological environment fund project reserves.





**Figure 3.** Restoration capital input and number of restoration projects.

In Figure 3, since 2017, the Chinese government has invested heavily in soil pollution remediation projects. In 2017, it invested 11.2 billion yuan. In 2018, it decreased to 3.5 billion yuan. On the one hand, this was due to the partial completion of the national soil pollution survey. On the other hand, market capital flooded into the field [16]. In 2017, the scale of China's soil pollution industry was only 8.69 billion yuan, which increased to 14.16 billion yuan in 2018. In 2019, government investment rose to 5 billion yuan, and the market size dropped to 11.84 billion yuan due to the impact of the financial crisis. In 2019, the market size and the number of restoration projects increased sharply. In 2020, the market size was 14.27 billion yuan, and the number of projects was 3521, with growth rates of 20.52% and 107.36%, respectively. The official implementation of the "Soil Pollution Prevention and Control Law" injected new vitality into the soil pollution remediation industry and provided legal protection and support [17]. The average price of soil pollution remediation projects in 2019 was 6.9729 million yuan, while in 2021, it dropped to 4.3243 million yuan. Soil pollution remediation enterprises increased from 17,469 in 2019 to 43,733 in 2021. With the influx of a large amount of funds and technology, after the implementation of the Soil Pollution Prevention and Control Law, various provinces carried out a series of soil pollution prevention and remediation projects based on the actual situation and achieved certain results. All provinces conducted comprehensive investigations on heavy chemical enterprises and agricultural production land, focusing on monitoring plots with pollution risks and carrying out planned remediation of contaminated plots. Table 5 illustrates the selected provinces with outstanding performance. Among them, the data come from the "China Ecological Environment Status Bulletin" released by the Ministry of Ecology and Environment as well as the soil pollution prevention and control results announced by the ecological environment bureaus of various provinces and cities.

Table 5 shows the achievements of some provinces in China before and after the implementation of the Soil Pollution Prevention and Control Law. All provinces conducted comprehensive surveys on heavy chemical enterprises and land used for agricultural production, focusing on monitoring the plots with pollution risks and carrying out planned remediation of the contaminated plots. After the implementation of the Soil Pollution Prevention and Control Law, the use of pesticides and fertilizers in Beijing has decreased by over 40%, and 13 heavy metal emission reduction projects have been completed. Liaoning established a farmland classification management system, with a stable agricultural film recovery rate of over 85%, and rectified 26 unqualified construction land pollution remediation projects. Sichuan repaired over 800 contaminated mines. Anhui completed risk control and restoration work on 20 contaminated land plots and corrected over 100 non-standard soil management cases through remote sensing monitoring. The qualified rate of risk assessment for construction land in Zhejiang is 85.71%, and the qualified rate of

restoration effect assessment is 93.33%. Moreover, 91% of contaminated farmland could be safely used. Shanxi completed 41 measures for soil pollution prevention and remediation and carried out remediation projects on eight confirmed contaminated plots. After the implementation of the Soil Pollution Prevention and Control Law, it has played an essential role in the prevention and control of soil pollution.

**Table 5.** Achievements of China’s provinces (municipalities) in soil pollution prevention and control (partial).

Province (Municipality)	Partial Results
Beijing	The use of pesticides and fertilizers dropped by more than 40%; Completed 13 heavy metal emission reduction projects; Completed the survey and monitoring of cultivated land and construction land.
Liaoning	Established a classified management system for agricultural land, and the recovery rate of agricultural film was stable at more than 85%; Remediation of 26 unqualified construction land pollution restoration projects.
Sichuan	67.82 million mu of grassland ecological protection and restoration; The ecological restoration area exceeded 200,000 hectares; Rehabilitation of more than 800 polluted mines.
Anhui	Completed a comprehensive survey of 693 contaminated plots; Completed the risk control and restoration of 20 contaminated plots; More than 100 cases of irregular soil management were corrected through remote sensing monitoring.
Zhejiang	The pass rate of construction land risk assessment was 85.71%, and the pass rate of restoration effect assessment was 93.33%; 91% of contaminated farmland could be used safely.
Shanxi	41 soil pollution prevention and repair initiatives were finished; Created a monitoring system for the 38 main polluting companies; Carried out remediation works on 8 confirmed contaminated plots.

## 5. Problems Existing in the Implementation of China’s Soil Pollution Remediation Legal System

China’s soil pollution remediation projects have made great progress in the years before and after the implementation of the “Soil Pollution Prevention and Control Law”. However, there are still many problems in the practice process. The development of soil pollution remediation projects is restricted by the imperfect setting of soil remediation responsibilities, vague soil remediation standards, an unsound financial security system, and low public participation.

### 5.1. Defects in the Legal System

According to Article 97 of the Law on the Prevention and Control of Soil Pollution, qualified agencies and organizations may bring environmental civil or administrative public interest litigation to the court for actions that pollute the soil and harm the public interest. Thus, the accountability of soil pollution remediation in China is the coexistence of administrative accountability and judicial accountability. There is no clear regulation on which method or both to use in the specific accountability process, resulting in differences in responsibility assumptions [18]. In addition, the Chinese legal system has certain flaws in the determination of the responsible person. Thus far, the subject of responsibility has expanded from a single administrative subject to actual polluters, land-use-rights holders, local governments, and construction units. According to relevant regulations, the actual polluter should bear the main responsibility for restoration. When the actual polluter cannot be identified, the land user is responsible for restoration. The law does not clearly provide for the participation of local governments in soil pollution remediation. That is to say, although the responsibility and obligation of soil pollution remediation has been set

for the local government, it has not been stipulated that this obligation should be fulfilled under such circumstances. In the current practice of soil pollution remediation, if there is no government participation, the ability and enthusiasm of actual polluters or land-use-rights holders will be difficult to ensure timely and effective remediation [19,20]. However, the law does not clearly stipulate the circumstances under which local governments need to participate in the restoration, leading some local governments to shirk and evade their responsibilities.

Achieving the goal of soil pollution remediation is the ultimate goal of soil pollution remediation work. Soil pollution remediation standards refer to the cleanliness level that the soil can achieve when the goal is to not cause harm to human health and ecosystems [21]. However, in the practice of soil remediation, there is no unified soil pollution remediation standard in China, which brings difficulty to the soil pollution remediation work. Although the “Soil Pollution Prevention and Control Law” stipulates the risk management and control standards for agricultural land and construction land, it is not sufficient as a legal basis for restoration work. Some local governments have formulated appropriate local standards according to the actual situation in their administrative regions, but the quantity and quality cannot meet the requirements of China’s soil pollution remediation work.

Soil pollution remediation requires a great amount of funds. Currently, China’s soil pollution remediation funds are mainly provided by the government. There is no healthy funding guarantee system [22]. Article 46 of the “Soil Pollution Prevention and Control Law” clearly stipulates that the actual polluter shall bear the remediation costs. However, the actual polluter is often unable to bear the cost, and the local government finally pays the bill. Soil pollution remediation is a continuous work that requires a stable source of funding [23]. Soil remediation exists to protect the public interest. Therefore, efforts need to be made to attract potential social capital to obtain funding.

### *5.2. Lack of Public Participation*

The direct beneficiaries of the soil pollution remediation project are the general public. Allowing the public to directly participate in related activities can not only supervise the efficiency of the project as a direct beneficiary but also stimulate the enthusiasm of the public [24]. In China, limited by the insufficient disclosure of information on soil pollution remediation projects, the participation of the public is low. Many people do not even know that there are soil pollution remediation projects around them [25]. According to Article 40 of the Soil Pollution Prevention and Control Law, during the restoration period, the progress and methods of restoration must be made public in the form of bulletin boards. However, this method is too simple, and the transmission scope is limited. In addition, because soil pollution remediation projects may involve commercial secrets of enterprises, many enterprises are unwilling to disclose relevant information during the remediation process.

Both the “Environmental Protection Law of the People’s Republic of China” and the “Soil Pollution Prevention and Control Law” stipulate the principle of “popular participation”. Unfortunately, the above documents fail to provide detailed regulations on the ways and channels of public participation [26]. This leads to some people knowing and wanting to participate but not knowing how to participate. Meanwhile, China’s social supervision methods mainly include media supervision, reporting, complaints and suggestions, etc. Compared with the powerful restoration enterprises or administrative departments, the supervisory individual is not strong enough [27]. The scope of cases that are accepted is rather restricted. The current law sets stringent limitations on the requirements of the subject of environmental public interest lawsuit, making it impossible for the public to fully exercise oversight function.

## **6. The Enlightenment of EU Countries’ Soil Pollution Remediation Legal System to China**

Since the 1970s, soil pollution has caused serious harm to human health and the environment. Countries all around the world have started to create legislation to safeguard

clean soil and remediate polluted soil [28]. The European Commission believes that there is no need for a soil pollution prevention and restoration law for the entire EU. However, member states can issue relevant policies based on their own conditions [29].

#### *6.1. Soil Pollution Remediation Legal Systems in Some EU Countries*

In Austria, there is no direct law on soil pollution at the national level but indirect protection by curbing soil erosion, improving biodiversity, or controlling floods and landslides [30]. At the regional level, the “Salzburg Land Regional Planning Act” and the “Vorarlberg Land Spatial Planning Act” are promulgated. The main purpose is to guide the orderliness of urban growth boundaries and avoid land pollution caused by urban fragmentation and blind expansion. The Austrian spatial development concept provides general objectives for soil quality and landscape conservation [31].

The Belgian cantons advocate an integrated approach to improving soil quality while considering soil properties. To spread awareness of soil protection, a public database of soil pollution conditions has been constructed [32].

The Czech Republic has formulated a plan to regulate the agricultural land every five years. As the effectiveness of the plan is verified, some regulations have been issued to solve soil problems such as soil loss, degradation, compaction, or desertification [33].

Denmark has formulated a soil prevention and restoration law based on the principle of “polluter compensation”. There are clear provisions on the standard of environmental damage, how to determine the responsibility, and how to take remedial measures [34]. In addition, Denmark has also addressed the issue of agricultural land biodiversity through a pesticide tax. Finally, the pollution problem is stressed by introducing regulatory solutions related to sustainable agricultural practices, stipulating the types and quantities of waste that can be used for agricultural purposes, and making pollution regulation legal [22].

Estonia has implemented a national environmental monitoring program. The main purpose is to protect water, air quality, and wildlife populations. Additionally, it has added a program dedicated to the protection of agricultural land. A detailed survey of agricultural land across the country is carried out to determine the geological characteristics and basic soil parameters of different soils. Financial assistances are only provided by the government if it is verified that the chemical or physical characteristics of the soil have changed [35].

France has formulated a series of laws and regulations from the perspectives of urban planning, environmental protection, agricultural land, and forest protection. The focus is to guide the public to pursue common management goals. Various agricultural associations are created to unite landowners and increase public participation [36,37].

Germany has established a strict soil pollution monitoring system to observe and track changes in soil-related functions [38,39]. By organizing students to participate in environmental protection, the harm of soil pollution and how to protect soil are publicized. From a regulatory point of view, agriculture and construction land are regulated and protected through three major bills. They are the Federal Soil Protection Act, the Building Plan, and the National Orderly Development Strategy. Germany has also extended the responsibility for soil pollution to land owners, users, and occupants and has set up a limited retrospective liability system [18,40]. This system expands the scope of responsible persons and reduces the burden of remediation on actual polluters and local governments.

Italy has developed a decree on sewage sludge and a regional waste management plan. The purpose is to standardize the quantity and waste management of sewage sludge used in agriculture to guarantee the organic matter content of agricultural land and avoid pollution during landfilling [41,42]. In addition to regulating agricultural land, the Alpine Soil Conservation Convention provides for regulation of forestry to minimize the effects of soil erosion and soil erosion.

#### *6.2. The Reference Significance of EU Countries’ Soil Pollution Remediation Legal System to China*

It is easy to observe that EU countries represented by Austria not only consider soil pollution when formulating soil pollution remediation plans but also develop systematic

plans including urban construction, ecological environment protection, soil and water conservation, etc., which provides reference significance for the overall planning of soil pollution remediation work in China.

In terms of determining the responsible party, the current legal system for soil remediation in China has certain deficiencies in determining the responsible person. However, Germany's soil remediation system can be utilized for reference. In addition to expanding the scope of responsible persons, the German soil remediation system also adopts a limited liability system that traces back to the past. This system can reduce the repair burden of actual polluters and local governments to a certain extent.

In terms of repair funds, the systems of Estonia and Denmark are worth learning. By imposing a certain pollution tax, local governments can supplement funds for soil pollution. Strict review of government subsidy conditions can solve the problem that some responsible people have the ability to repair but are not willing to repair, and this further solve the lack of a sound financial security system for soil pollution remediation funds in China.

In terms of increasing public participation, reference can be made to the systems of France and Germany. The owners of agricultural and construction land-use rights shall establish a joint management organization and supervise each other within the organization. After the land is polluted, the adjacent land-use-right holder shall bear part of the responsibility for restoration. The hazards of soil pollution are widely publicized in schools, communities, factories, and rural areas. The public is encouraged to participate in soil pollution risk control and remediation. To improve the transparency of soil pollution remediation information, public databases such as that in Belgium can be established on the government's official website, allowing stakeholders to promptly check the progress and methods of remediation.

## 7. Discussion and Conclusions

In China's current environmental protection system, the soil pollution remediation system is still in the early stages. From the perspective of legislative roots, it is still immature and has many problems. Especially in determining the responsibility for soil pollution remediation, there is a lack of substantive and procedural norms. When the responsibility for soil pollution remediation cannot be determined, the central or local government often pays the bill. The responsibility for soil pollution remediation is a strong guarantee for the soil pollution remediation system. The nature, applicable subjects, and procedural norms of soil pollution remediation responsibilities need to be further clarified. At the same time, the responsibilities of local governments and relevant departments should be refined to prevent them from taking on too much responsibility or evading responsibility. In this issue, the German soil remediation system not only expands the scope of responsible persons but also adopts a limited responsibility system that traces back to the past. To some extent, this system can reduce the repair burden on actual polluters and local governments. Therefore, the main body of soil pollution can be determined by referring to Germany's responsibility system. Then, it is necessary to clarify the standards for soil pollution remediation. The remediation goal is the ultimate goal of soil pollution remediation activities. Scientific standards can indicate the goals that need to be achieved in soil pollution remediation. At present, most European countries prioritize human health and ecological security as their values, such as the EU countries represented by Austria. When formulating soil pollution remediation standards, they consider society and nature. The principles of adapting measures to local conditions and adjusting measures are followed. This provides reference significance for the overall planning of soil pollution remediation work in China. Soil pollution control still requires a large amount of funding investment. Therefore, it is necessary to optimize the source of funding for soil remediation. Relying solely on government subsidies is not a long-term solution when the polluters are unable to bear huge costs. China should improve the fund system for soil pollution remediation, absorbing remediation funds from stakeholders in the whole society for soil pollution

remediation. Taking Estonia and Denmark as reference, the problem that the funds for soil pollution remediation in China have not formed a healthy financial security system was also herein discussed. Finally, it is necessary to strengthen the public participation mechanism, strengthen information disclosure, improve the social participation rate and transparency of soil pollution remediation, promote public participation enthusiasm, and improve the quality and efficiency of remediation. It is possible to establish a joint management organization for agricultural and construction land-use-rights owners by referring to the systems of France and Germany and supervising each other within the organization.

Soil pollution remediation is a long-term and complicated work limited by various circumstances. The study fails to analyze specific guidelines for soil pollution remediation in European countries. There is also no feasibility analysis on how to establish a sound soil pollution remediation fund. Future research can be carried out in this direction. At the same time, under the influence of national policies, various provinces and cities in China have actively responded to the call. Relevant policies have been introduced based on our own actual situation and regional characteristics, promoting the sustainable development of China's soil remediation industry. To promote soil pollution remediation in China and leverage the regulatory role of China's soil pollution remediation legal system in soil pollution remediation, the soil pollution situation in provinces and cities such as Beijing and Hebei will be tracked.

**Author Contributions:** Z.L., Y.Y. and Y.Z. conceived the research idea and designed the study. Z.L. and S.S. collected the data. Z.L. and Y.Z. performed data analysis. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The data used to support the findings of this study are available from the corresponding author upon request.

**Conflicts of Interest:** The authors declare no conflict of interest.

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