



**China Council for International Cooperation on Environment and
Development (CCICED)**

**Special Policy Study on
Soil Pollution Management**

CCICED

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Summary of Key Findings

Building an ecological civilization is the overall objective for China's economic and social development strategy as promoted by the Communist Party of China (CPC). The comprehensive consideration of this future direction for the country takes into account the current situation of economic and social development. To expedite this effort, the Political Bureau of the CPC issued the "Opinions on Accelerating the Construction of an Ecological Civilization" in March 2015 and then, in September 2015, the Central Committee of CPC and the State Council jointly issued the "Overall Plan on the Institutional Reform for an Ecological Civilization". China is pursuing the building of an ecological civilization in order to guarantee the sustainable and healthy economic and social development of the country..

The key to build a society that can be characterized as an ecological civilization is environmental protection. Ecological civilization requires great emphasis on strengthening environmental governance by improving and modernizing the governance institutional system and strengthening the national and local capacity to deliver results. Soil pollution has become a major threat to the food safety, human health and ecological safety and is a common concern around the world. The United Nations set the year 2015 as the first International Year of Soil with the theme "healthy soils for a healthy life" aiming to raise public awareness of the important functions of soil in food safety and ecological systems, in order to protect the soil environment and increase the appreciation for soil as a natural resource.

Soil, like air and water, is the source of all life on the earth. Soil is the major resource of food for human beings. It is a vital resource which supports the existence, security, prosperity and sustainable development of a whole country. If soil is polluted and the soil environment is destroyed, no matter which state or nation, will pay for what they have done.

China is a large developing country. Rapid economic growth has created tremendous wealth in China as well as severe environmental problems: water pollution, air pollution and soil pollution. Soil pollution is now one of the most prominent environmental problems. A series of soil pollution incidents such as poisoned rice, cadmium contaminated rice, poisoned land and lead poisoning has resulted in social instability and even public panic in some areas. In 2012, some Chinese scientific researchers wrote a letter directly to the State Council requesting for the soil pollution management to be addressed

Soil pollution management in China is just getting started and is faced with tremendous challenges and difficulties such as the absence of laws and regulations, the ambiguity of liability,

lack of accountability and, poor management capacity. China needs to address these soil pollution management challenges.

The first task to meet the soil pollution challenge is to develop a soil law to provide a legal basis for soil environmental management and soil pollution management. This law needs to be supported by a clear management framework to guide government officials and all other stakeholders in the management of soil. International experience has shown that, soil environment standards are indispensable for soil pollution management. China needs to establish a science based integrated soil environment standard system with the basic design principle of protecting human health and ecological safety in order to meet the current and future needs for Chinese soil pollution management.

The management of legacy soil pollution, which is a common challenge for most countries, mainly covers two important issues: the establishment of a clear liability system that assigns responsibility for the clean-up of legacy contaminated sites and the creation of fund dedicated to the clean-up of legacy contaminated sites. However, for legacy contaminated sites, the subject of liability is difficult to track and define, either because responsible parties are out of business or do not have the capacity for remediation. International experience has shown that special measures should be taken for the management of legacy soil pollution.

Soil pollution management requires a complex, systematic and long-term effort. The development of a soil law can only meet the basic and primary need for strengthening or improving soil pollution management. A soil law cannot solve all the problems. Hence, it is important to develop and improve the overall legal system of laws and regulations as it relates to soil and develop effective enabling mechanisms for the soil pollution management. This should be the most important focus for soil management initiatives and capacity building in the immediate future.. To date emphasis has been placed on the investigation, classification, risk assessment and remediation of contaminated sites. These efforts need regulations and guidance of relevant laws and rules. The development of laws and regulations concerning the investigation, classification, risk assessment and remediation of contaminated sites should be ranked as a top priority for soil pollution management capacity building undertakings.

Summary of Main Policy Recommendations

Recommendation 1. Confer on Soil Fundamental National Policy Status

Fundamental National Policy Status in China is given to those most important basic policies capable of stabilizing society and the country. Only the issues which concern basic rule of law and guarantee the existence and development of the country can be considered for Fundamental National Policy Status. Soil is unique amongst mediums of air and water as it is an irreplaceable and limited natural resource required for the sustainable social and economic development of China. Soil is recommended to receive fundamental national policy status because it: is the growing medium for food, forests and agricultural crops; has the ability to store vast quantities of water and carbon; serves as a natural filter and is essential to maintain China's biodiversity and ecosystems; is unique amongst the mediums of air and water as it does not have the same ability to move or cleanse itself and when polluted becomes the root cause for adverse effects on health, safety and the environment; and is irreplaceable. To date, soil pollution in China, especially agricultural land contaminated with heavy metal as the main pollutant, has not been effectively controlled, thereby reinforcing the need for securing Fundamental National Policy Status for soil. Soil is the basis of national wealth creation and is integral to defining China's culture, heritage and people, as well as the construction of an ecological civilization. The protection of soil will improve the quality of China's soils and safeguard their ability to provide essential services for future generations while securing the health, safety and economic well-being of its citizens. A national soil vision statement is recommended for adoption to promote creation of an integrated regulatory, legislative and political framework to provide appropriate protection of soil. Besides, the protection of public health and safety is integral to China's soil governance. All China's soils must be managed sustainably, degradation threats addressed and significant risk to citizens and the environment mitigated or eliminated.

Recommendation 2. Develop a Comprehensive “Soil Environment Protection Act” and Establish a Regulatory System for Soil Management Based on this Act

It is international common practice to develop laws and regulations to protect the soil. The Standing Committee of the 12th National People's Congress has listed the “*Soil Pollution Prevention Act*” in its agenda. International soil management experience, the emerging China soil related issues of carbon storage, soil resiliency to climate change and the unique nature of China's soil pollution management challenges, suggests the need for an expanded scope for any proposed *Act*, beyond pollution prevention. A more integrated, comprehensive and renamed “*Soil Environment Protection Act*” is recommended. The scope of “*Soil Environment Protection*

Act” is much wider than “*Soil Pollution Prevention Act*”, which is able to address at a minimum:

- protection of clean soil, especially, agriculture soils;
- reasonable use of soil resource;
- prevention of soil pollution;
- protection of soil during development;
- remediation of legacy sites;
- redevelopment of contaminated sites.

This “*Soil Environment Protection Act*” is consistent with the trend of next generation soil regulation development seen internationally, which recognizes that:

- only focussing on the prevention of soil pollution is not enough to protect human health and ecological functions; and
- there is a move away from an individual sector approach to an integrated approach where a much wider scope for protection can be achieved.

Recommendation 3. Establish Management Framework for Soils

Creating a clearly defined management framework is critical to the establishment of a national soil protection management system, for consensus building and joint effort of stakeholders. Consequently, a soil management framework that is consistent with the national vision for soil environment protection and reflects the comprehensive “*Soil Environment Protection Act*” is recommended to be established. Safe soils for agriculture (with a focus on food safety) and the management of risks from contaminated sites (past, present and future) must be the initial priorities. Using base principles the management framework, will provide the structure for development of:

- policies and procedures to prevent further soil degradation or pollution;
- legacy site and legacy practice action programs; and

- specific programs on immediate response to imminent and substantial risks resulting from accidents (Tianjin) or sites where new information becomes available.

The management framework implementation success will be enhanced through:

- development of enabling mechanisms;
- institutional strengthening; and
- building of stakeholder capacity.



Recommendation 4. Establish a Science Based Integrated Soil Environment Standard System and Incorporate into the Comprehensive “Soil Environment

Soil standards are the basis for soil environmental management. A science based integrated soil environment standard system is recommended in order to improve soil management practices. The proposed soil environmental standards system will have region specific background values which will define clean soil. There will be screening values for contaminated soils which when exceeded will trigger the need for a site investigation and risk assessment. Once remediation is required there will be target values which will define the result of the remediation. Based on the differences in the way humans may be exposed to contamination there will need to be a distinction between arable (agricultural) land and industrial land.

Currently, priorities for soil environmental management must be the protection of uncontaminated soils and the management of risks from contaminated soils. For protection of uncontaminated soils, soil environmental standards based on background concentrations should be derived. For historically contaminated soils, risk-based soil environmental standards should be derived taking into account soil contamination risks to humans, ecological species/functions and groundwater. For contaminated soils which pose unacceptable risks to humans or ecological functions, site-specific soil remediation objectives (target values) should be derived using the national generic methodology.

The proposed principles for the design of soil environmental standards are the:

- protection of human health;
- protection of ecological species/functions and the protection of the quality of groundwater; and
- protection of clean soils (standstill principle).

It is recommended that the principles of the system and the status of the standards be incorporated in the “*Soil Environment Protection Act*”.

Recommendation 5. Establish a Liability System and Soil Remediation Fund in order to Resolve Soil Pollution Problems.

Legacy contaminated sites are those existing contaminated sites where the subject of liability is difficult to track and define, responsible parties are out of business or do not have the capacity for remediation. It is recommended that China take special policy measures to address legacy contaminated sites by:

- establishing a clear liability system that assigns responsibility for the clean-up of legacy contaminated sites;
- creating a fund dedicated to the clean-up of legacy contaminated sites; and
- organizing a national and provincial level survey on the classification and risk assessment of legacy contaminated sites for future clean-up.

It is also recommended that China take special responsibility and finance policy measures to address contamination that may occur from current or future operations.

Recommendation 6. Implement Selected Key Priority Enabling Mechanisms to Facilitate the Success of Soil Environmental Protection

Establish a Process for the Redevelopment of Contaminated Sites. It is recommended that a defined four step process that follows a plan, study, remediate and develop approach be established to guide the redevelopment of any contaminated sites at the national, subnational or local levels. All stakeholders involved in the four step process from government agencies, insurers, financial institutions, developers, consultants and others will be deemed accountable for actions they are assigned responsibility for within the process. This will include but not be limited to assessing the site for contamination, identifying the regulatory requirements for site safety and clean up, developing and carrying out the appropriate remediation or risk management plans, reassessing the site and if needed implementing an ongoing monitoring plan. Several financial instruments are recommended to be developed specifically for those sites that are candidates for redevelopment, for instance, tax incentives and waiving of governmental fees at the national and subnational levels to serve as a catalyst for clean-up. This includes the concept that those that invest in remediation, share in any financial return from land remediated. Rezoning of land use to raise rehabilitated contaminated site value is another option recommended based on fit for use results from the site specific risk assessment undertaken. It is also recommended to set up a Soil Bank to Protect Clean Soil during Development and Urbanization.

Establish an Information System. It is recommended that a system be developed that will allow public access to and distribution of all relevant information to all affected stakeholders regarding the status of soil and its potential impact on health, safety or surrounding environment. The right to know, the right to be heard and the right of appeal by stakeholders is proven in international experience to be one of the best approaches to ensure that proper management solutions for soil is identified and implemented. Traditional environmental management takes a command and control mode, while modern soil pollution management involves cooperation and collaboration with an emphasis on enabling more public participation.

Establish a Quality Assurance Process. It is recommended that a quality assurance process be adopted that covers all stakeholders involved in the process of site identification, classification, characterization, remediation and monitoring to ensure the integrity of the soil environmental management process. This includes but is not limited to:

- recognized professional status (ex. engineering, science, law, business);

- current license to practice (degrees/diplomas/professional certifications, associations);
- quality assurance certifications for all laboratories undertaking analyses;
- personal sign off accountability for site characterization, remediation, monitoring reports and data submissions; and
- transport system, disposal site and technology vendor certifications.

Background and Summary of the Study

Background

Soil is the basic building block for life and the resource for other natural elements. Soil is also the material basis for human existence and development, as well as a strategic resource for economic and social development of a country and a nation. Soil pollution in China is becoming a severe issue due to rapid economic growth that was undertaken, without taking into account environmental and social costs of that growth. According to China's Bulletin of National Soil Pollution Circumstances Survey, soil pollution in some areas of China is quite serious, the farmland soil environment quality is alarming, and the soil environmental problems of contaminated industrial waste lands become prominent. To strengthen soil environment protection and address oil pollution management are becoming urgent tasks for China.

In order to implement the rule of law on soil environment protection, the Standing Committee of National People's Congress has listed the establishment of "*Soil Pollution Prevention Act*" within its legislation plan for proposed promulgation in 2017. The China Council for International Cooperation on Environment & Development, CCICED has undertaken this Special Policy Study on Soil Pollution Management under the name of "Legal Regulation and Incentive Mechanism on Soil Environment Management".

This CCICED report provides recommendations for consideration on the safeguarding of China's soils over the long term. It provides a clear vision to guide future policy development across a range of areas and sets out clear practical steps that will need to be taken to prevent further degradation of China's soils, enhance, restore and ensure their resilience and improve China's understanding of the threats and best practices in responding to them. This report reflects input from international best practices and clearly demonstrates the value of national action which is responsive to sub national, municipal and local circumstances

Developing Policies for Soil Environmental Protection in China-2010

The technical foundation for the current report was actually laid by a CCICED report which was commissioned in 2010 entitled *Developing Policies for Soil Environmental Protection in China*. This study had a number of key recommendations that builds on and helped shaped the current report analysis. These recommendations included:

- Establish a Cross Ministry Working Group that has political support to draw up laws, codes and relevant systems
- Attach equal importance on Soil pollution prevention and Soil reuse
- Strengthen soil environment quality supervision in basic farmland and major agricultural production areas
- Attach importance to supervision of high risk industrial sites that are contaminated
- Draw up management measures for contaminated sites based on risk management methods with the protection of human health, soil ecology and groundwater as a priority
- Attach importance to stakeholder partnerships
- Establish a soil environment management system suitable for China's actual conditions
- Establish a registration system for contaminated sites at point of property transaction
- Improve China's soil environment standard system
- Set the National and Local Guiding Standards for Soil Quality
- Undertake assessments of remediation technologies
- Implement soil remediation demonstration projects
- Develop financial capital mechanisms, including the assignment of funding for projects to be by the local governments with the central government responsible for encouraging private capital
- Develop list of pollutants requiring control in different agricultural regions by product type
- Establish soil record and information management systems of contaminated sites
- Establish screening systems for soil restoration technologies and develop technologies and equipment for polluted soil restoration
- Establish mechanisms for sharing soil environment data in China.

Project Timeline

The current project was launched on March 23, 2015. During the process of this SPS, the project team has held four working meetings and several internal meetings of Chinese expert team and international expert team. Besides, the project team has organized an investigation in Wuhan and a study tour to United States and Canada.

- On March 23, 2015, the first working meeting was held in Beijing. The main objective of this meeting was to discuss on the working mechanism for the work assignment and cooperation between the two expert teams.
- On April 11-12 2015, the second working meeting was held in Wuhan to discuss on the framework of policy recommendations and the work plan for next period. The expert team organized a field trip and a meeting with BCED Environmental Remediation CO., LTD.
- During the period of June 7 to June 17, 2015, the Chinese expert team visited Chicago, Washington DC and Toronto and met with people from the U.S. EPA, U.S. EPA V Region, EPA of Illinois, Ministry of Municipal Affairs & Housing of Toronto, Hamilton Planning & Economic Development Department, AECOM, NRDC, EDF, Gowlings Law Firm and University of Chicago. Active discussions were held on soil environment legislation, soil environment management, redevelopment of brownfields, “*Super Fund Act*”, soil remediation, public participation in soil environment protection.
- On July 22-24, 2015, the third working meeting was held in Shanghai to discuss the content of the report and revising the framework of policy recommendations.
- On September 11 - September 12, 2015, the fourth working meeting was held in Guangzhou to discuss on revision of the first draft, revision on the summary policy recommendations and the schedule of the next period.

Key Words: Soil protection; Pollution management; Policy recommendations

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1.0 CURRENT STATUS OF SOIL POLLUTION MANAGEMENT IN CHINA AND NEED FOR LEGAL REGULATION

1.1 Soil Pollution in China

Along with air and water, soil is key to sustain life. If China were to destroy its soil, it would destroy itself. The understanding of soil's value and its impact on China's economy and the ongoing development of Chinese society is critical for the nation to thrive. Good quality soils are essential to achieve Ministry of Environment Protection (MEP), Ministry of Agriculture, Ministry of Housing and Urban Rural Development, Ministry of Water Resources and other stakeholder goals of a thriving farming sector and a healthy, sustainable food supply, as well as securing a healthy environment in which future generations can prosper without the threat of adverse impacts from soil contamination.

Recent reports have revealed that soil pollution in China is serious, the farmland soil environmental quality is alarming, and the soil environmental problems of waste land of the mining industry have become prominent. Industrial activities, former and current mining operations, agricultural activities as well as atmospherically transported pollutants are all important reasons for the soil pollution challenges China is facing today. In addition, there are high background levels of certain metals and elements in the soil, bedrock and groundwater in some regions, contributing to increasing the man made pollution problems.

The first national survey on soil pollution. Ministry of Environment Protection and the Ministry of Land and Resources jointly conducted a national survey on soil quality in China between 2005 and 2013. Summary of the results were released in 2014 in the Bulletin of National Soil Pollution Survey¹ (hereafter the Bulletin), concluding that the general condition of China's soil environment is not optimistic. Some areas are suffering from serious soil pollution, the environmental quality of the arable land is worrying, and there are outstanding environmental problems in industrial and mining deserted lands. 16% of the surveyed soils were classified as polluted². For the agricultural soils the ratio of polluted soil was even higher, at 19.4%.

The spatial distribution/pattern of the data summarized in the Bulletin has not been published, but the Bulletin indicated that the pollution in the southern part of China is worse than the northern part, and that it is particularly serious in areas of Yangtze River Delta, Pearl River Delta, and the historical industrial bases in northeast China. South-western and central regions of China have found wide range heavy metal pollution. The content of cadmium, mercury, arsenic and lead elevates from northwest to southeast, and from northeast to southwest. Though no specific data on soil pollution trends have been exposed, the Bulletin indicated that the soil pollution in China is increasing. The survey reported in the Bulletin had a strong focus on heavy metals pollution, although other aspects were also covered.

¹ Source: http://english.gov.cn/policies/latest_releases/2014/08/23/content_281474983026954.htm

² Divided into 11.2% classified as slightly polluted, 2.3% mildly polluted, and 1.5% moderately polluted and 1.1% severely polluted.

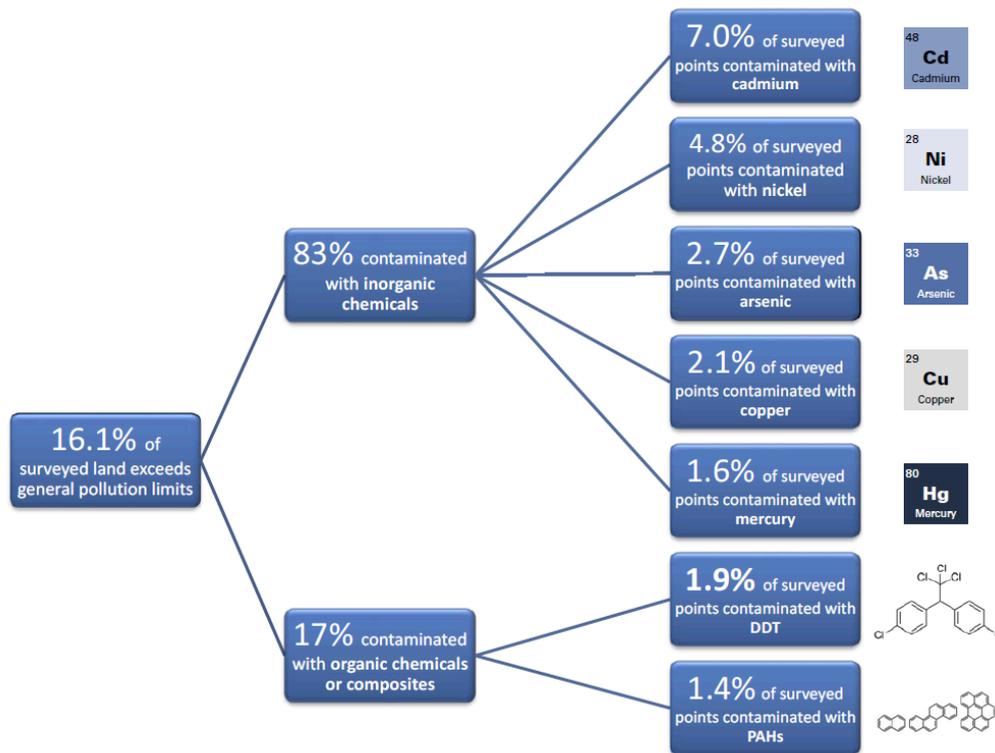


Figure 1-1: Polluted Soils in China

Figure 1-1 is an illustration of the results of polluted soils in China as reported in the National Soil Pollution Survey Bulletin by the Ministry of Environment Protection and the Ministry of National Land and Resources. 16% of all soils and 19% of the agricultural soils are categorized as polluted. Around heavily polluting enterprises, more than a third of the soils were polluted. Drawing from the Goldman Sachs report on China’s environment³.

National survey on beneficial and harmful elements in soil. In 2015, China Geological Survey under the Ministry of Land and Resources published another national soil quality survey “Geochemical Survey Report on Chinese Farmland”⁴. The focus in this survey was the presence of beneficial and harmful elements in the soil. The study reports that nearly 92% of the investigated agricultural soils had heavy metals concentrations below the national standard limit values; in other words, 8% of total investigated arable land has been contaminated. 5.7% was classified as slight-mild heavy metal polluted and 2.6% moderate-severe. The survey also reported on changes in other soil quality properties, including reduced organic matter content in the North-east, increased acidity in the South and increased alkalization in the North. More than 20% of the soils were reportedly badly hit by acidification, and almost 30% showed a tendency of alkalization with soil hardening, reduced fertility and nutrient availability.

³ 13 July 2015 Goldman Sachs Report on China’s environment.

⁴ Source: http://en.cgs.gov.cn/UploadFiles/2015_06/30/r-SuntGeochemical%20Survey%20on%20Chinese%20Farmland.pdf.

Soil's ability to sustain food production and food safety. In another national survey, where the primary focus has been the soil's ability to sustain food production and food safety, maps have been published showing the quality class, taking both nutrient status and heavy metals pollution into account⁵ (Figure 2). In this study, as much as 34% was classified as having some level of nutrient deficiency, while regarding heavy metals, 60% were classified as clean, 29.5% as less clean and 2.6% as polluted.

The large fraction of soils with nutrient deficiency is also an illustrative example of how the environmental compartments are interlinked: The nutrient deficiency of soils first of all illustrates that the soils have lost some their important functions. As a response, the farmer will add more fertilizer, resulting in more nutrient runoff to surface waters, causing eutrophication, deteriorated water quality and toxic algal blooms. It also causes increased atmospheric emissions of nitrogen compounds, which will contribute to increasing levels of secondary particles (PM2.5), as well as being potent greenhouse gases. Hence, keeping soils healthy not only matters for the soil function and food production, but also for water quality and air quality.

Pesticides. Another important link between soil and water quality is pesticide use in the agricultural sector and subsequent pollution of aquatic ecosystems. This is an issue that is not easily covered in the large scale soil quality surveys, and requires assessment of biological sample matrices. China is one of the largest producers and consumers of pesticides in the world today and the increase in pesticide use and production the last two decades is enormous (Figure 3). Along with the widespread use of pesticides and industrialization, with direct impacts on soil quality and function, there is a growing concern for water quality deterioration from pesticide residues. In a recent literature review, the eco toxicological risk pesticides pose in aquatic ecosystems were assessed. A large fraction of the results from the reviewed studies are given an environmental classification of “very bad” based on pesticide levels in biota, with the risk for DDT generally being the highest (Figure 1-2). The review also revealed a poor geographical representation, with the majority of studies have been undertaken in vicinity of the largest cities. Hence, many of the most important agricultural provinces (e.g., Henan, Hubei and Hunan), with the largest pesticide use, have been the subject of few studies on the environmental levels of pesticides. Also, there is a lack of studies in remote Chinese environments.

⁵ Yang ZF, Tao Y, Hou QY, Xia XQ, Feng HY, Huang CL, et al. Geochemical evaluation of land quality in China and its applications. J Geochem Explor 2014;139:122–35.

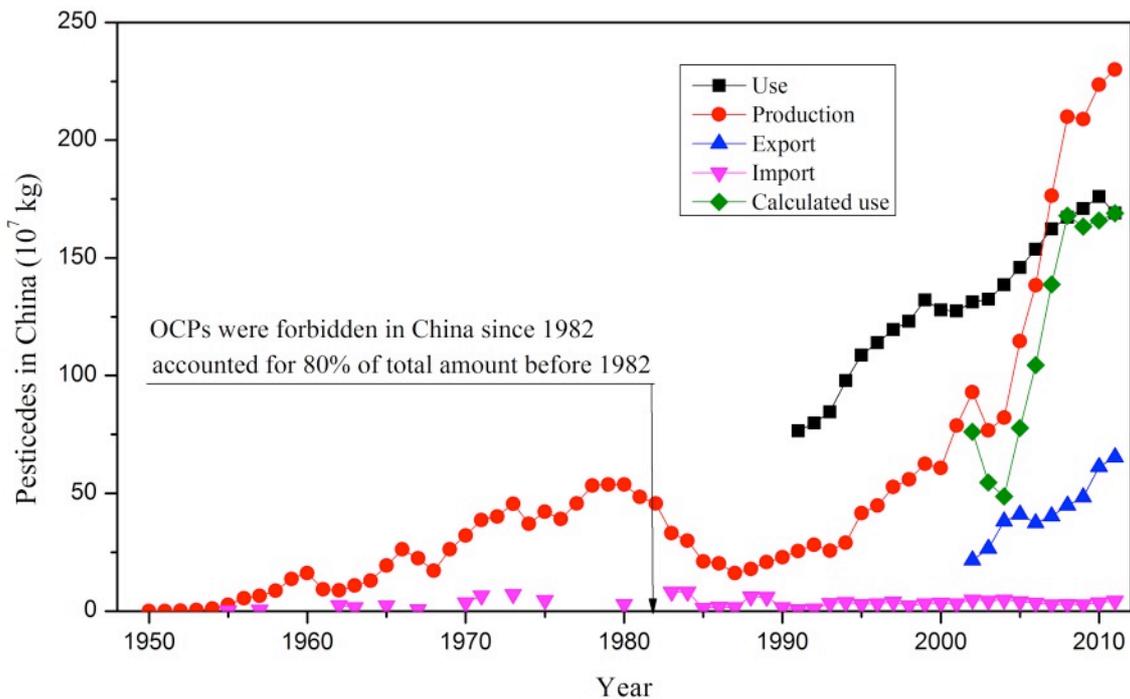


Figure 1-2: Historical Production, Use, Export and Import Amounts of All Pesticides in China⁶

Acid rain and soil acidification. Soils are also impacted by pollution depositing from the atmosphere, including heavy metals and acid rain. Acid rain has been a major concern in China, especially due to sulfur emissions from the burning of coal, but also to some extent from atmospheric nitrogen emissions. This has resulted in deteriorated soils, with lowered pH, lost base cations and reduced buffer capacity, being a threat to forest health. It has been estimated that 16% of the Chinese territory has soils where the critical load of acid from the atmospheric deposition is exceeded (Figure 1-3). Soil acidification poses a long-term risk both for forest ecosystems and for agricultural production, since acidification of soil result in loss of beneficial base cations in the soil (such as calcium) and mobilization of aluminum ions, with potential harmful effects on plant roots. Reduced growth of forests and crops is already happening. In the longer term, forest death is a possible scenario.

⁶ Grung, M., Lin, Y., Zhang, H., Steen, A.O., Huang, J., Zhang, G., Larssen, T., 2015. *Pesticide levels and environmental risk in aquatic environments in China - a review*. Environ. Intl. doi: 10.1016/j.envint.2015.04.013t.

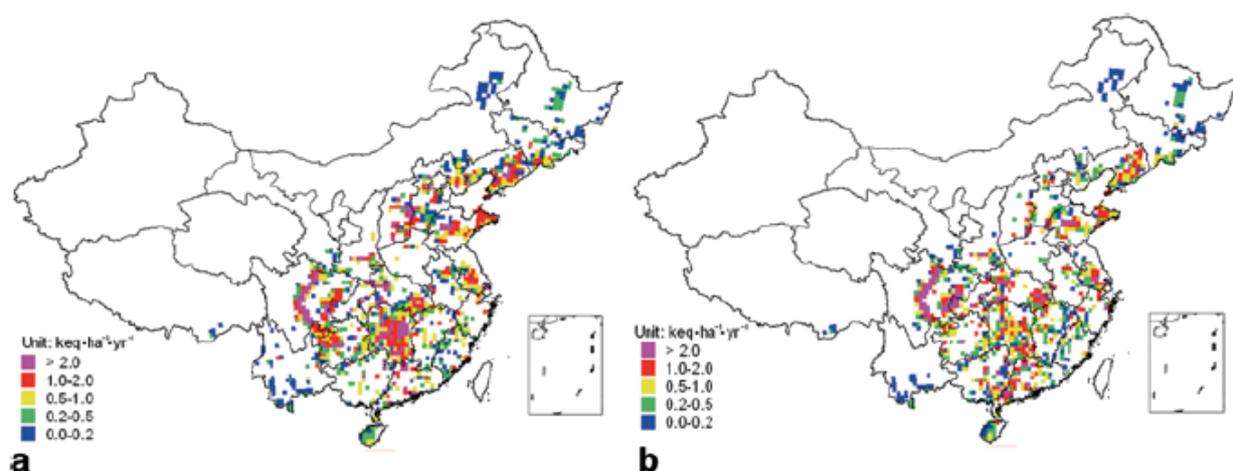


Figure 1-3: Maps Showing the Potential Impact of Acid Rain on Chinese Soils

Colors show to what extent the soil's critical load for acid deposition (sulfur and nitrogen) is exceeded at a) deposition observed in 2005; and b) the deposition predicted for 2020.⁷

Heavy metals from mining areas. Heavy metal pollution from, and in the surrounding areas of mining areas is of particular concern in China. The affected areas may be relatively limited, but the pollution levels might be high, posing a particularly high risk for the local population. A recent review paper summarized available data in the literature (2005-2012) on heavy metal polluted soils in mining areas in China and estimated risk levels to human health⁸. The review demonstrated severe heavy metal pollution and subsequent high carcinogenic and non-carcinogenic risks to the public, especially to children and those living in the vicinity of heavily polluted mining areas (Figure 1-4).

⁷ Duan, L., Zhao, Y., Hao, J., 2015. Critical Load Assessments for Sulphur and Nitrogen for Soils and Surface Waters in China. In de Vries, W., Posch, M., Hettelingh, J.-P. (Eds.): Critical Loads and Dynamic Risk Assessments. Springer. Environmental Pollution Series, Vol. 25.

⁸ Li, Z., Z. Ma, T. J. van der Kuijp, Z. Yuan and L. Huang, 2014. A review of soil heavy metal pollution from mines in China: pollution and health risk assessment. *Sci Total Environ* 468-469: 843-853.

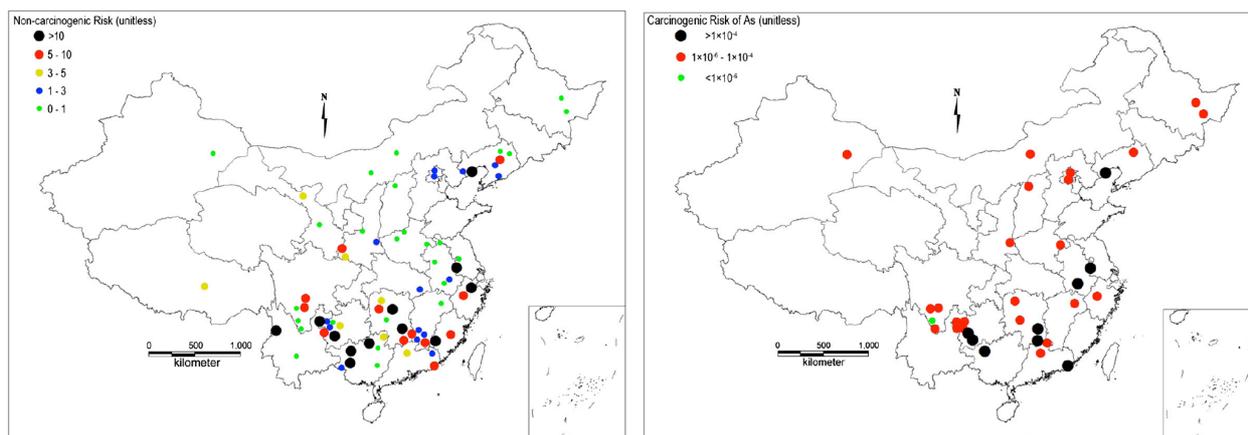


Figure 1-4: Maps Showing Distribution of Non-Carcinogenic and Carcinogenic Risk Levels to Human Health from Heavy Metals and Arsenic Originating From Mining Areas in China.

Irrigation with polluted surface water. A considerable fraction of China’s agriculture and grain production is dependent on irrigation and water shortage is a severe challenge, especially in northern China. As a result, irrigation water of poor quality is being used, including polluted surface water and waste water⁹. This is resulting in a gradual build-up of contaminants in the soil, potentially being transferred to the crops and posing a food safety risk. The use of waste water or sewage contaminated surface water for irrigation may also increase the risk of contaminating food crops with pathogens.

Contaminated groundwater. Soil pollution is closely linked with groundwater pollution, as pollutants stored and accumulated in soils may gradually migrate to the ground water. Once groundwater is contaminated, recovery is a very slow process. The quality status of Chinese groundwater is poor: According to a report by the Ministry of Land and Resources in 2014, almost 60% of the nation’s groundwater is polluted and classified as unsuitable for drinking. 44% of the monitored sites were ranked as “relatively poor” and 16% as “very poor”.¹⁰

Mr. Li Ganjie, Deputy Minister of MEP, expressed his great concern on the soil pollution issue in China as follows:

“If no powerful measures would be made, the soil pollution in China will be irreversible, and soil pollution will be an important problem that will harm the public health and social order.”

“As showed by the various surveys and investigations, the soil pollution in China has arrived very serious degree. If the soil pollution is left untreated, even the food supply will be a problem in some areas.”

⁹ Li, Z., Z. Ma, T. J. van der Kuijp, Z. Yuan and L. Huang (2014). "A review of soil heavy metal pollution from mines in China: pollution and health risk assessment." *Sci Total Environ* 468-469: 843-853.

Lu, Y., S. Song, R. Wang, Z. Liu, J. Meng, A. J. Sweetman, A. Jenkins, R. C. Ferrier, H. Li, W. Luo and T. Wang, 2015. Impacts of soil and water pollution on food safety and health risks in China. *Environ Int* 77: 5-15.

¹⁰ Source: http://english.gov.cn/policies/latest_releases/2014/08/23/content_281474983026954.htm

Soil pollution in China is particularly challenging. Soil pollution in China is a complex issue and the challenges can be summarized in the following three key points:

- (1) China's rapid development has caused a superposition of a range of serious pollution issues developing rapidly and within the same, short period of time. In many developed countries and regions the process of industrialization, urbanization and modernization lasted for more than a century and the related environmental pollution problems to a larger extent occurred at different stages and periods in time. In China, on the contrary, most types of pollution became serious in a short period of time in the last 20-30 years. This may be particularly challenging, but also gives opportunities in terms of integrated pollution control.
- (2) China's soil pollution challenges are complex, due to the many different pollution types and sources, the large quantities of pollutants involved and the large areas and number of people affected. Pollution types include heavy metals and organic micro pollutants; pollution on agricultural land and on industrial land; caused by human activities, geological process, sewage irrigation, atmospheric deposition, and improper disposal and treatment of solid waste.
- (3) Various risk caused by soil pollution. The soil pollution for agricultural land can lead to the absorption of pollutants by crops, polluting the food chain and triggering food safety problems. The soil pollution in residential land can lead to human health risk through direct exposure, and the pollution to ground water and surface water raises problem for potable water. In addition, soil pollution can also lead to microbial pollution and spread of pathogens.

1.2 Current Status of Soil Governance and Management

A major milestone in Chinese soil pollution management took place in 2005, when the State Council issued a Decision on "implementing scientific outlook and strengthening environment protection" (hereafter the Decision). This Decision explicitly stipulated the following points: 1) soil pollution prevention is a focal point in order to strengthen the environmental protection in rural areas; 2) a national soil pollution survey and a comprehensive management of contaminated arable soil should be undertaken; 3) the use of pesticides, fertilizer, agriculture plastic film and so on should be reasonable and well controlled; 4) severely contaminated soil that requires complicated remediation should be regulated by law. This was the first time that Chinese government issued a document directly related to soil pollution problem, and the Decision thus became a prelude to the soil pollution management in China.

As demanded by the Decision, the Ministry of Environment Protection and the Ministry of National Land and Resources began a nationwide survey on soil quality in 2005. The survey lasted for nine years, and the final survey report was released on April 17 2014. The survey provided a data basis for the soil pollution management in China. In order to implement the Decision of 2005, the Ministry of Environment Protection issued an "Opinion on strengthening soil pollution prevention", providing a comprehensive plan and specific demands for soil pollution management.

On 15 December 2011, the 12th Five-year Plan on National Environment Protection was issued by the State Council. This plan stated that soil environment protection should be strengthened, and that soil environment protection should be regarded as an urgent and important environmental problem. It also emphasized the construction of soil environment protection legal systems, soil environment supervision and the soil remediation on key contaminated area.

On 23 January 2013, the State Council issued a “Notice on recent work arrangement of soil environment protection and comprehensive management”, which provides the objective, main tasks and measures on soil environment protection and comprehensive management. According to the Notice, the main tasks are to strictly control the increasing of soil pollution; define the priority protection area for soil environment protection; highlight the risk control of soil pollution; carry out the soil remediation; strengthen the soil protection supervision capacity, and accelerate the soil environment engineering construction. From the year 2014, the Ministry of Environmental Protection has been working on the development of an “Action Plan on Soil Pollution Prevention”, which is expected to be issued before the end of 2015.

Government Department	Main Responsibilities	Major Legislations
<i>Central Government Ministries:</i>		
Ministry of Environmental Protection	<ul style="list-style-type: none"> • Overall administration on pollution management including soil pollution management • Monitoring on pollution • Environmental Emergency Response 	Law of Environmental Protection
Ministry of Land & Resources	<ul style="list-style-type: none"> • National Administration of land resources (ownership, land-use planning, etc.); • Organize land survey & land statistics • Land reclamation • Protection of cultivated land • Land revitalization 	Land Administration Law & Regulation on Land Reclamation
Ministry of Water Resources	<ul style="list-style-type: none"> • Soil & water conservation • Soil erosion monitoring 	Law of Soil & Water Conservation
Ministry of Agriculture / State Forestry Administration	<ul style="list-style-type: none"> • Monitoring of agricultural soil & soil improvement • Administration on soil safety for agro-products • Safety administration on use of Pesticides and fertilizers in agricultural land • Administration on use of forestry land and protection of forestry land 	Law of Agriculture, Law on Quality and Safety of Agricultural Products, Law of Forestry
Ministry of Housing &	<ul style="list-style-type: none"> • Administration of rural urban planning; 	Law for Rural Urban Planning

Government Department	Main Responsibilities	Major Legislations
Rural-Urban Development	<ul style="list-style-type: none"> Administration of construction projects 	
National Health & Family Planning Commission	<ul style="list-style-type: none"> Develop and implement interventions for public health issues that seriously endanger people's health; Develop regulations, standards and policies on environmental health, public place health and sanitary standards for drinking water 	
<ul style="list-style-type: none"> <i>Relevant local government & departments</i> 		
Local Government	<ul style="list-style-type: none"> Responsible for environmental quality of its jurisdiction; Responsible for the management of public utilities, facilities and services in water supply, sewage water treatment and sanitation 	
Local environmental protection department / bureau	Overall administration on environmental management including soil pollution management within jurisdiction	Law of Environmental Protection
Department of Land & Resources	<p>Within its jurisdiction:</p> <ul style="list-style-type: none"> Land administration and supervision; Land survey with other departments; Supervision on land reclamation; Protection and treatment of soil erosion 	Land Administration Law & Regulation on Land Reclamation
Department of Water Resources	Water & soil conservation	Law of Soil & Water Conservation
Department of Agriculture & Forestry	<p>Within its jurisdiction:</p> <ul style="list-style-type: none"> Monitoring of agricultural soil & soil improvement Administration on soil safety for agro-products Safety administration on use of Pesticides and fertilizers in agricultural land Administration on use of forestry land and protection of forestry land 	Law of Agriculture, Law on Quality and Safety of Agricultural Products, Law of Forestry
Department of Housing & Rural-Urban Development	<p>Within its jurisdiction:</p> <ul style="list-style-type: none"> Administration of rural urban planning; Administration of construction 	Law for Rural Urban Planning

Government Department	Main Responsibilities	Major Legislations
	projects	
Provincial and municipal Health & Family Planning Commission	Within its jurisdiction: <ul style="list-style-type: none"> • Develop and implement interventions for public health issues that seriously endanger people’s health; • Develop regulations, standards and policies on environmental health, public place health and sanitary standards for drinking water 	

Table 1-1: Main Responsibilities and Major Legislation Supports of Relevant Government Departments in Soil Pollution Management

Table 1-1 presents a brief description of the respective current responsibilities of the government ministries and departments related to soil pollution management in China. Table 1 also identifies the relevant laws and regulations that defines each of their responsibilities. Government ministries and departments promote their own plans and priorities for soil protection and pollution management, as there is no comprehensive law or regulation to coordinate the efforts of each department. It was determined during our research for this study that a new law that is focussed on soil pollution management that is under development, has decided to clearly define the responsibilities of relevant government departments involved in soil protection and pollution management at both central and local level.

From 2011, soil environment management has been explored at the local level in China. Some examples of cities and provinces having established measures or action plans are:

- Beijing, where an environment management experts committee of contaminated sites has been established in October 2014.
- Shanghai, where measures are established on environment safety in the process of redevelopment of industrial and municipal sites in April 2014.
- Jiangsu, where a trial plan on soil environment protection and comprehensive management has been issued in July 2013.
- Zhejiang, which has established an action plan on clean soil in July 2011.
- Chongqing, which has issued a Notice on environmental protection measures on industrial solid waste left by enterprises to be closed, faced with bankruptcy and to be relocated in February 2011.

The above mentioned plans, policies, regulations and standards concerning soil pollution management both on the national and local level, have accumulated practical experience for the management of soil pollution in China.

Environmental standards are important as tools for environment management. The standards in China consists of two categories: 1) environmental quality standard, this is the standard to evaluate the environmental quality of a certain object; 2) standard monitoring methods, this category consists of the certified methods by MEP which will be used by all the official monitoring stations in China, and is usually the only accepted method for official use. Currently there are several standards related to soil environment protection in China, including national standards for soil environment quality, environmental standards for various agricultural products, assessment standards for soil environment quality, standards for soil pollution control and methodology standards for soil pollution monitoring. The most relevant standards for soil pollution are summarized in Table 1-2.

Code	Name	Issued	Into force
HJ 350—2007	Standard of Soil Quality Assessment for Exhibition Sites	2007-06-15	2007-08-01
<p>This standard applies to exhibition sites, consists two categories: Category I, human beings may be directly exposed to soil; Category II, other sites except Category I, for example, venues, green area, commercial or municipal facilities. The environmental levels consists two classes: Class A, uncontaminated soil; Class B, contaminated, if the level exceeds Class B, actions must be taken to remediate to reach Class. Contaminant levels exceed Class A but below Class B can be used for Category II sites. 92 contaminants are included in this standard, including 14 inorganic, 24 volatile organic, 47 semi volatile organic and 7 other types (pesticides, PCBs etc.)</p>			
HJ/T 332-2006	Farmland environmental quality evaluation standards for edible agricultural products	2006-11-17	2007-02-01
<p>This standard applies to agricultural soil, consists three limit values depending on the soil pH: below 6.5, 6.5-7.5 and above 7.5, and two limit values depending on types of crop: paddy field or dry land. 12 contaminants are included in this standard, including 8 metals, 2 pesticides, total rare earth elements and salinity. Any soil that contains contaminants above the limit values cannot be used as agricultural production.</p>			
HJ/T 333-2006	Environmental quality evaluation standard for farmland of greenhouse vegetables production	2006-11-17	2007-02-01
<p>This standard applies to vegetable production soil in greenhouses, consists three limit values depending on the soil pH: below 6.5, 6.5-7.5 and above 7.5. 11 contaminants are included in this standard, including 8 metals, 2 pesticides and salinity. Any soil that contains contaminants above the limit values cannot be used as vegetable production in greenhouses.</p>			
HJ 53-2000	Interim regulation for acceptable levels of residual radionuclides in soil of site considered for release	2000-05-22	2000-12-01
<p>This standard applies to decommissioned sites for nuclear facilities or activities that cause increased radiation levels above the natural levels. If the standard is met, the decommissioned sites can be open for public use. The standard is set based on the annual radiation dose is 0.1 mSv. And corresponding concentrations of radioactive elements that can cause this level radiation dose are limited.</p>			
GB 15618-1995	Environmental quality standards for soils	1995-07-13	1996-03-01
<p>First environmental soil standard. This standard divides the soil into three categories: Category I, national nature reserve, collective drinking water sources and some other protected soils; Category II, normal crop or vegetable farmland, tea yard, fruit yard and pasture land. The environmental levels consists three classes : Class I, natural background level; Class II, elevated but still suitable for agricultural activities and not harmful for human health; Class III, elevated but plants can still grow unaffected. Class II which is the standard for agricultural use consists three limit values depending on the soil pH: below 6.5, 6.5-7.5 and above 7.5, and two limit values depending on types of crop: paddy field or dry land. 10 contaminants are included in this standard, including 8 metals and 2 pesticides. Note: new draft standard of GB 15618-2008 has been opened for public opinion feedbacks for years, but still not issued.</p>			

Code	Name	Issued	Into force
HJ/T 166-2004	The Technical Specification for soil Environmental monitoring	2004-12-9	2004-12-9
This standard explains in details how to do soil environmental monitoring, including routines for deciding sampling points, sample preparation, analysis method, results presentation, information collection and quality assessment. It applies for all the soil related monitoring in China.			
GB/T 18834-2002	Soil quality - vocabulary	2002-9-11	2003-2-1
This standard defines all the soil quality related terms, explains the technical meanings of each all the terms.			
Standard analytical methods for a range parameters of soil, including organic carbon, metals, pesticides, dioxin, organics, nitrate, sulfate, phosphorus, etc.: HJ 695-2014, HJ 680-2013, HJ 679-2013, HJ 658-2013, HJ 650-2013, HJ 649-2013, HJ 642-2013, HJ 635-2012, HJ 634-2012, HJ 605-2011, HJ 613-2011, HJ 614-2011, HJ 615-2011, HJ 631-2011, HJ 632-2011, HJ 491-2009, HJ 77.4–2008, GB/T 17134-1997, GB/T 17135-1997 , GB/T 17136-1997, GB/T 17138-1997, GB/T 17139-1997, GB/T 17140-1997, GB/T 17141-1997, GB/T 14550-93			

Table 1-2: Overview of Environmental Standards and Environmental Monitoring Methods for Soil Pollution¹¹

1.3 Challenges of Soil Management in China

Since the 11th five-year plan (2006-2010) there has been a growth in China’s awareness regarding soil pollution management resulting in several soil pollution management policies and regulations being issued. However, compared to water and air management, soil management in China is still at the primary stage.

The main problems for soil management in China can be summarized in four reasons which have greatly restricted or hindered the effective development of soil management in China:

- (1) China lacks acts and regulations on soil environment protection or soil pollution prevention. The “Opinion” of the Ministry of Environment Protection clearly pointed out that a series of acts and regulations on soil pollution prevention would be promulgated in 2015. However, no acts or regulations have been passed so far. The primary basis is the “Opinion” of the Ministry of Environment Protection and the “Decision” of the State Council.
- (2) There is a lack of soil management institutions and weak capacity for surveillance on soil environment. Chinese environment protection bureaus at any level have currently not created a special soil environment protection or soil pollution prevention department. Responsibility for soil environment protection and soil pollution prevention currently lies with the rural work department under the direction of the ecological division of MEP. At local levels, the function of soil environment protection and soil pollution prevention is also undertaken by the counterpart of rural work department under direction of ecological division of MEP.

¹¹All the environmental standards in China are summarized on MEP’s official website <http://kjs.mep.gov.cn/hjbhbz/>.

- (3) Further, an improved soil environment standard system is lacking. In China, the “Soil environment quality standard” (GB15618-1995) is mainly applied to the soil environment management of rural land. However, standards such as the “Soil environment quality standard”, “Soil pollution risk control standard”, “Standard for soil remediation”, “Standard of reception for soil remediation” which will apply for industrial sites remain absent.
- (4) Finally, there is the issue of lacking a financial guarantee for soil remediation, which potentially requires large funds. Presently, the main financial support for soil remediation comes from the government as well as the land developers, which can be limited and unstable.

1.4 The Need for Legal Regulation for Soil Pollution Management in China

Law is the basis or guarantee for management. The absence of effective acts and regulations is a key reason for the soil management problems faced by China.

Despite the lack of adequate legislation, there are relevant provisions related to soil environment protection and soil pollution prevention in the “*Environment Protection Act*”, “*Water Pollution Prevention Act*”, “*Air Pollution Prevention Act*” and others. However, these provisions are not sufficient to meet the requirements of soil environment protection or soil pollution prevention for four reasons:

- (1) Insufficient legal systems on soil environment protection or soil pollution prevention leads to a lack of basis and guarantees for soil pollution management.
- (2) The provisions related to soil environment protection, usually comprising one or two articles in an act, are fragmented and less than systematic, which is far from satisfactory.
- (3) Further, the current related provisions lack relevance, and are by-products of other *Acts*. They are not specifically tailored to meet the requirements of soil environment protection or soil pollution prevention, which makes these provisions relatively ineffective.
- (4) The current related provisions are abstract and lack operationalization, which makes them impractical and difficult to implement.

These insufficiencies of soil environment legislation have significantly affected the soil pollution management in China. China should quicken its pace on the legal management on soil environment, especially regarding the pace of soil environment legislation, with the aim of strengthening soil management generally and improving the capacity level of soil pollution management specifically.

2.0 INTERNATIONAL EXPERIENCE AND ENLIGHTENMENTS ON SOIL POLLUTION MANAGEMENT

2.1 Formulating Legal Frameworks for Comprehensive, Integrated Systems of Soil Environment Protection

It wasn't until the 1970's and thereafter, in response to the discovery of the severe damage to the environment from the unregulated management and disposal of hazardous substances and an urgent call for action from concerned citizens, that developed countries world-wide began enacting laws both to protect the soil and also to clean up the legacy of existing soil contamination. Although the background for legislation and the design of soil laws themselves vary, most developed countries went from regulating soil pollution indirectly through multiple, piecemeal laws regulating media specific contamination in the air and water, to the enactment of special legislation directed expressly at the protection and remediation of soil.

GERMANY: The German government has enacted a systematic legislative system to address soil contamination with the Federal Soil Protection Act at its core. The Federal Soil Protection and Contaminated Sites Ordinance, the Closed Substance Cycle and Waste Management Act, the Federal Pollution Control Act, the Fertilizer Act, the Soil Valuation Act and other federal laws serve as support to this law and various sub-federal laws also act as complements¹².

The Federal Soil Protection Act, which came into force in 1999, is a specific law to protect soil at the federal level. The act obliges the owner and the user of the land and those who may impact soil to prevent and remove soil pollution. On the basis of soil value and other related requirements, the federal government can enact policy and regulations to regulate suspected contaminated sites, identify sites, protect against harmful soil change, and provide for clean-up of pollution. On the basis of the Federal Soil Protection Act, the Federal Government passed the Federal Soil Protection and Contaminated Sites Ordinance on 17 July 1999. The ordinance includes: the investigation and evaluation of suspected sites, the remediation of adverse soil alterations and contaminated sites, preventing the risk of adverse soil alterations resulting from soil erosion by water, precautions against the formation of adverse soil alterations and so on.

NETHERLANDS: The Netherlands was one of the first European countries to pay take legal action to respond to the problem of contaminated sites. In the 1970s, soil pollution was discovered in Lekkerkerk, which triggered the enactment in 1983 of the Interim Soil Remediation Act. In 1987, the government revised the Interim Soil Remediation Act and

¹² Source: http://faolex.fao.org/cgi-bin/faolex.exe? database=faolex&search_type=query&table

published a Soil Protection Act, as amended in 1994 and in 2006. The provisions of these laws are particularly instructive because of the method they use for allocating legal liability for protection and clean-up of soils is based on ownership of the property, contribution to contamination of property and the timeframe in which the contamination occurred relative to the passage of the Federal legislation. This framework for assigning liability, particularly as it relates to the establishing liability from the date of passage of legislation, is a potential model for China due to China's unique system of state-owned land and enterprises.

The Danish government also recognized the problem of chemical waste landfill pollution enacting the Chemical Waste Disposal Act in 1983; a revision in 1990 included management of numerous pollutants. In 1999, the government promulgated the Contaminated Soil Act addressing all types of soil.

UNITED STATES: In response to public outrage and concern over the health impacts from former hazardous waste disposal sites like the Love Canal and the Times Beach, the U.S. Congress enacted a series of laws, commencing in the 1970's, that provide a comprehensive and integrated system for the protection of soil and of the ground and surface water, air, and ecosystems associated with the land. The basic components include: (1) RCRA, which was designed to prevent and control solid waste pollution from operating industry from "cradle to grave"; (2) CERCLA, which is targeted at the clean-up of uncontrolled or abandoned hazardous waste sites and also of spills, accidents and other emergency releases of pollutants or contaminants into the environment; (3) the Surface Mining Control and Reclamation Act of 1977 ("SMCRA"), which applies to the impacts caused by mining activities; and, (4) OPA, which directs clean-up of oil spills on land or water. General mechanisms and responsibilities for preventing and controlling soil waste pollution are mainly in RCRA while compensation and clean-up liability are in CERCLA, respectively¹³.

In 1986, the US Congress enacted SARA, based on lessons learned during the first years of implementing CERCLA. These amendments were to strengthen the implementation provisions of CERCLA, encourage voluntary clean-ups by legally responsible parties, reduce litigation, emphasize the importance of permanent and innovative treatment technology, increase participation by state governments in all aspects of implementing CERCLA, and to facilitate and encourage public participation. Besides, SARA also includes the first Emergency Planning and Community Right-to-Know Act ("EPCRA"). The U.S. Congress passed the Small Business

¹³ Source: <http://www.epa.gov/agriculture/llaw.html>

Liability Relief and Brownfields Revitalization Act (the Brownfields Act) in 2002 in order to encourage brownfields redevelopment, as a supplement of CERCLA.

JAPAN: The Japanese government passed the Agricultural Land Soil Pollution Control Act in 1970 and has amended it numerous times. In 2002, the government promulgated a Soil Contamination Countermeasures Act and the Ministry of Environment published implementing regulations. The Agricultural Land Soil Pollution Control Act's goal is to prevent and clean-up farmland contamination resulting from specific, harmful substances and rationally use the contaminated agricultural land. The Act includes: designation and modification of agricultural land; soil pollution measurement area zones; enactment and modification of agricultural land soil pollution measure projects; designation and modification of special area zones; investigation and measure of the conditions of agricultural land soil pollution; criteria for field surveys: and recommendations concerning the production of agricultural crops.

The Soil Contamination Countermeasures Act facilitates the implementation of countermeasures against soil contamination by Designation of Hazardous Substances so as to protect the health of citizens and prevent harm to human health resulting from such contamination. This Act includes soil contamination investigation, designation of contaminated zones, pollution clean-up, change of form of land and the plan of land use, designation of an investigation institution, promoting substantive law, etc.

Japan has legislation not only specific to soil protection, but also a large number of other laws related to soil prevention such as an Air Pollution Control Act, an Act with Special Measures concerning Dioxin, a Water Pollution Control Act, a Waste Disposal Act, a Fertilizer Banning Act, and a Mine Safety Law. By controlling air pollution, dioxin pollution, water pollution, solid waste pollution, certain chemical pollution, fertilizer and pesticide pollution and mine pollution, these laws collectively prevent pollution from different sources so that the objective of soil pollution prevention can be achieved¹⁴.

KOREA: In 1995, Korea enacted its Soil Environment Conservation Act, which has been amended six times. The purpose of this Law is to prevent soil contamination resulting in risks to human health and the environment, protect healthy soil ecosystems, enhance the value of soil resources and create a healthy living environment.

¹⁴ Liang Jianqin, Main Models of Legislation on Soil Pollution Control in the World, law Review, Vol 149, issues 3, 2008: 85-91.

Generally, legal frameworks for soil pollution prevention internationally include most of the following items:

- A specified scope or objective for the law including: pollution prevention; remediation of contaminated sites, economic incentives for the redevelopment of contaminated property and/or risk abatement of imminent and substantial endangerment threats to human health and the environment;
- Specific goal(s) for the law e.g., protection of human health and the environment; insure that agricultural lands are safe for food production; mitigation and/or elimination of risk, etc.;
- Clear identification of individuals or enterprises regulated under the law, i.e., property or enterprise owners, business operators, remediation contractors, polluters, real estate developers, financial institutions, government entities, etc.;
- An assignment of responsibilities for implementing the provisions of the law, i.e., owners and operators of facilities handling hazardous substances must provide financial assurance during the operation of their business to address any spills or releases of these substances;
- A management framework for implementation of the law; e.g. the roles and legal authorities of various national government agencies and the relationship with and authorities of sub-national jurisdictions;
- Enforcement provisions and penalties for non-compliance with the law and incentives to encourage voluntary compliance;
- Express provisions for public participation, community involvement and transparency;
- A funding mechanism to insure adequate resources to satisfy the law's objectives and build capacity, e.g. training, resources and education, for implementation: and,
- Requirements for monitoring, record keeping and reporting of activities, emissions and releases of hazardous substances.

Research Conclusions:

While the research group was doing its foreign investigation and survey work, many experts and scholars suggested that some current soil environmental protection laws are deficient by not emphasizing soil pollution preventive measures enough and by over-emphasizing remedial,

clean-up measures. Further, this research suggested that too much reliance was being placed on the actions of the government in some countries rather than placing responsibility squarely on the polluter. Therefore, in designing China's new Soil Environment Protection Law, the soil pollution prevention system should be further perfected and the principle of "polluter pays" should be implemented. Additionally, due to the legal and technical complexity of protecting and remediating soil, China's special legislation for soil environment protection cannot itself include all of the detailed requirements necessary for soil environmental protection. Therefore supporting administrative and technical regulations and regional and provincial legislation also will be necessary. China's soil legislation framework needs both a specific and comprehensive environmental protection law and a soil environmental protection regulatory system.

2.2 Establishing a Comprehensive Soil Management System and Remediation Action Plan

The management of soil pollution must not rely on emergency responses to accidents, spills and accidental releases of hazardous substances but must focus instead on prevention, management of risk, and long-term remediation. The laws of different countries establish management systems and require governments to formulate comprehensive soil management action plans, in order to establish short- and long-term targets and implementation procedures, all with the goal of protecting human health and the environment.

EUROPEAN UNION: Given the increasingly severe pollution and deterioration of its soil, the EU passed a Soil Thematic Strategy to strengthen soil protection in Europe. This Strategy includes: A proposed legislative framework for the protection and sustainable use of soil, in order to integrate soil protection into national and EU policies; Measures to improve knowledge of soil functions; and Measures to increase public awareness. It seeks to establish rational land use planning practices at all levels of government to ensure the sustainability of soils, consistent with a "precautionary principle" used by the EU in establishing environmental policy.

In November 2007, the European Parliament passed the EU soil framework directive which requires that Member States may adopt measures tailored to local needs, while establishing common principles, objectives, and actions to guide land use planning and management. The framework requires Member States to adopt a systematic approach for identifying and combating soil degradation. Member States also must integrate soil protection into other policies - especially with respect to agriculture, regional development, transport, and so on. Member States must identify areas at risk for erosion, organic matter decline, compaction, soil sealing, salinization, and landslides, as well as soils where these processes have occurred. Under the directive, a soil status report provided by the seller or buyer to government and other parties in

the transaction must accompany the sale of a potentially contaminated property. Member States must adopt programs to reduce these risks, inventorying contaminated sites and establishing national strategies for their remediation. Actions must include mechanisms to fund the clean-up of orphaned sites and steps to rehabilitate brownfield sites.

The draft EU Soil Directive has not been finalized. In November 2007, the European Parliament did reaffirm its support for public soil inventories, a list of potentially contaminated sites, and the requirement that Member States establish soil remediation strategies. Supporters of the directive have argued that a soil directive is important to help fight climate change because of the role soil plays as a carbon repository. Environment ministers from the United Kingdom, Germany, Austria, in particular, however, have taken the position that the Directive would interfere with existing Member State soil management measures and that it would be too costly to justify its environmental benefits.

On 13 February 2012, the European Commission published a policy report on the implementation of the EU Soil Thematic Strategy, which provides the implementation of the Strategy for Soil Protection since its adoption in September 2006 and ongoing activities. It has been estimated that, in 2004, the turn-over of the soil remediation industry in EU-27 amounted to €5.2 billion, of which 21.6% spent in Germany ranking first among all the member states. In the period 2007-2013, €3.1 billion have been allocated to the rehabilitation of industrial sites and contaminated land. Hungary, the Czech Republic and Germany have allocated the most funding (€475, 371, and 332 million respectively).¹⁵

UNITED STATES SITE REMEDIATION: In the United States, over 40,000 contaminated sites have been listed in the current Superfund Enterprise Management System data base since tracking began in 1980. Of these sites, approximately 1700 sites have been listed to date on the National Priorities List (“NPL”) of sites requiring remediation, under CERCLA authorities. Sites are listed after undergoing a preliminary assessment of existing records and information, a site inspection, scoring using criteria in the Hazard Ranking System to evaluate and rank the threats from the site to human health and the environment and public notice and comment along with concurrence from the governor of the state in which the site is located sites on the NPL can be cleaned up either voluntarily by or through enforcement actions against parties deemed responsible pursuant to the law including past and current owners and operators, transporters of hazardous substances, and generators of materials disposed of at the site. In the absence of

¹⁵ The implementation of the Soil Thematic Strategy and ongoing activities, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52012DC0046>

parties that can be identified or that are financially viable or responsible parties that refuse to act, the U.S. EPA can utilize the Hazardous Substance Response Fund, commonly known as “Superfund”, to clean up the site itself. Over the 35-year history of the Superfund program, Federal funding (minus settlement and private party clean-up expenditures, which are unknown) is roughly \$40 billion dollars.¹⁶

2.3 Establishing Appropriate Risk Based Standards

From a review of the current practices of relevant countries and regions, most developed countries have established health-based standards for the protection and remediation of the soil environment. These standards support the management system contained in their specific soil legislation and regulations and clearly state the function of the soil environmental standard value. The United States, the United Kingdom, the Netherlands, Canada, and Australia are among the countries that rely on risk control to set standards for contaminated soil. These countries establish risk evaluation methods for polluted soil, and formulate the soil environmental standard value based on risk, to assist in initial site screening and the investigation and evaluation of soil pollution. At contaminated sites, these countries generally conduct an evaluation of the polluted soil by analysing the site’s specific characteristics in conjunction with its intended land-use e.g., agricultural, residential, commercial or industrial, to determine the remediation target value of the contaminated soil. The relevant laws and regulations of some of these countries distinguish between and define “old” and “new” polluted soil based on criteria such as the promulgation date of various soil protection laws, e.g., the Netherlands, allowing for different clean-up values and measures for “old” contamination versus “new” pollution.

NETHERLANDS: In 1983, the Netherlands promulgated the Interim Soil Remediation Act, which includes the first generation of the A, B and C Values, based on background concentrations and expert judgment¹⁷. In 2009, the government revised the intervention values. If the average concentration measured of at least one substance in a soil volume of at least 25 m³ in the case of soil contamination, or a pore-saturated soil volume of at least 100 m³ in the case of groundwater contamination, exceeds the intervention value, a case of serious contamination is

¹⁶ In 2008, U.S. Government Accountability Office estimated that since 1981, Superfund appropriations have totaled over \$32 billion in nominal dollars, or about \$1.2 billion annually, <http://www.gao.gov/products/GAO-08-841R>

¹⁷ F.A. Swartjes, M. Rutgers, J.P.A. Lijzen, P.J.C.M. Janssen, P.F. Otte, A. Wintersen, E. Brand, L. Posthuma, State of the art of contaminated site management in The Netherlands: Policy framework and risk assessment tools. http://ac.els-cdn.com/S0048969712003294/1-s2.0-S0048969712003294-main.pdf?_tid=dc1d3872-57a9-11e5-88e7-0000aacb362&acdnat=1441882456_3da54389ddff2b7632b9f746bdbcf3e1

deemed to exist.¹⁸ Urgency of remediation is determined according to the present or future use of the soil.

DENMARK: According to the Contaminated Soil Act, the government of Denmark promulgated the Quality Criteria for Soil to more effectively supervise contaminated sites. The Quality Criteria for Soil are based on an assessment of risk to human health and have been established for sensitive land use. The Danish EPA registers sites where the concentration of contamination is higher than the Quality Criteria for Soil by placing them on a list of contaminated sites. Cut-off values have been established for pollutants. If the concentration of contamination is lower than the cut-off values, soil remediation is unnecessary, because the exposure of people can be limited to an acceptable level by reducing the opportunity for exposure to the soil pollutant. In addition to the Quality Criteria for Soil, the Danish Government also uses an evaluation of ecological risk to establish Eco-Toxicological Soil Quality Criteria.

2.4 Assignment of Responsibility

The promulgation of new law can be a boundary and take stricter control measures to new polluting source and polluting equipment in order to prevent new pollutions and clarify the legal responsibility.

Before the promulgation of soil environmental protection law, many countries have blank space in soil environmental protection system and supervision, which cause the accumulation of the problems of pollution. Therefore, it is necessary to take the promulgation of law as an opportunity, and strictly control the pollution and damage which may happen and eradicate new pollution. For example, the Dutch soil protection law which was promulgated in 1987 has stipulated the soil pollution which was caused after January 1st, 1987 should be repaired to the initial quality when the soil was first used; the soil pollution was caused before January 1st, 1987 should be considered whether it should be repaired or not based on relevant regulations. The Denmark soil pollution law has stipulated the soil pollution which was caused in 1991 should strictly implement soil pollution enforced investigation system; the soil pollution which was caused after January 1st, 2001 should strictly implement the accountability system of remediation's responsibility.

The legislations of many countries have stipulated that the polluter, the owner and user of land should take the obligation of protecting soil environment, take risk control and management and

¹⁸ Soil Remediation Circular 2009.

<http://esdat.com.au/Environmental%20Standards/Dutch/ENGELSE%20versie%20circulaire%20Bodemsanering%202009.pdf>

remediation responsibility for soil pollution. The Superfund Law has one of the strictest liabilities for compensation and remediation of US environmental legislations. It has significant effect to solve the soil environmental problems rapidly and effectively.

2.5 Establishing Adequate Financial Mechanisms to Meet Soil Remediation Needs

The management and the recovery of soil pollution require a large amount of fund, so the fund which fits the remediation responsibility provided by law is the key to implement the law effectively and recover the environment. The main problem the US Superfund Act aims at is that the problem has happened or the dangerous material pollution which has emergent threat. These problems require government to react immediately, when the actions of government can be defined as emergent reactions, so that when the parties can't be found or can't shoulder the responsibility, government should take measures beforehand and the government's actions can be defined as the administrative replacing managements. No matter what situations, the fund safeguard is always needed. The establishment of superfund has not only guaranteed the law enforcement capacity of government but also safeguarded the authority of laws and government.

2.6 Combining Environmental Protection with Economic Revitalization

In the past, the soil polluted by dangerous material means it would be abandoned permanently. Even though it can be safe after being cleaned or remedied, once it was tagged to the label of polluted soil, it might be isolated which becomes a permanent flaw in economy. Many countries' legislations have created relevant system which combines pollution remediation with redevelopment of polluted land. The recovery plan of brown field sites has not only encouraged more people to participate in the remediation and management of polluted land, but also promoted the redevelopment of land to achieve fine environmental, economic, and social effect.

There were some brownfield site issues in the US after a period of time from the promulgation of CERCLA. Brownfield site is real property of which the expansion, redevelopment, or reuse is very difficult because of the presence or potential presence of a hazardous substance, pollutant, or contaminant. Specifically, brownfields include those abandoned gas stations, dry cleaners, photo studios, industrial land and buildings that may contain hazardous substances etc. The fundamental reason why brownfields sites generated in the US is that the economic structure and industrial structure were readjusted and investment and industrial activities were expanded and transferred to remote underdeveloped areas, suburbs and overseas since the 1970s. The direct reason could be attributed to the promulgation of CERCLA of 1980. Since this Act provides severe environmental pollution liability and accountability mechanisms, some potential investors

and business activities prefer to choose some safe green lands, which are located in urban fringe or undeveloped areas, instead of these contaminated brown lands. As a result, on the one hand, there are a lot of abandoned lands in the city centre, producing numerous brownfields. On the other hand, developing a lot of good farmland in the edge of the cities and suburbs resulted in the rapid disappearance of green lands. This phenomenon not only caused wasted land but also generated serious social problems. Therefore, some old communities were reduced to poverty, at the same time, employment opportunities were greatly reduced and crimes in these places were increased etc. In order to solve these problems as a whole from a long-term, the federal EPA launched a Brownfield's Initiative Plan, authorizing the states, communities and other developers to govern and reuse brownfields jointly. In addition, the EPA drew up the Brownfields Federal Partnership Action Agenda in 1997. The US Congress passed the Small Business Liability Relief and Brownfields Revitalization Act in 2002 to encourage SMEs to participate in the brownfield redevelopment plan.

The main contents of this plan include: (1) Provide funding for brownfield assessment and clean-up demonstration projects. (2) Clarify responsibilities and cleaning items. This plan helps determining the limitation of the right of the EPA and clarifying the responsibilities and obligations of states and local governments when they develop these brownfields sites jointly. (3) Build partnerships. It was designed to establish partnerships among federal agencies, states, cities and communities in order to promote the clean-up process and public participation and community involvement in decision-making process. (4) Promote employment and training. Through environmental education programs, this plan can enhance the level of labour. Recruiting students, training workers from brownfields can create employment opportunities for the residents who live near these lands.

There were more than 500 projects that get money under this plan until 2000. The total numbers of this money got to \$160 million and these projects generated more than 7,000 jobs, driving \$2.3 billion private investments. This plan is not only a successful business program but also a successful social policy. According to the reuse of brownfield sites, these abandoned areas have the new hope and the employment, security and environment at these places get better than before¹⁹.

Local governments in Canada bear the main responsibilities in land exploitation and soil environmental protection. Municipal governments are responsible for fixing all their own

¹⁹ Environmental Protection Agency of US: Superfund's 25th Anniversary: Capturing the Past, Charting the Future. <http://www.epa.gov/superfund/25anniversary/>.

brownfields sites, the lands whose ownership returned to the city and some ownerless lands. And they also govern and regulate some related activities and programs of brownfields sites, which belonged to public institutions and private person. The useful experiences of municipal governments when they repair and redevelop brownfields sites are: (1) Provide tax incentives and exempt part of the municipal fee to encourage development. (2) Offer subsidies to environmental and feasibility study. (3) Guide developers through process management and approval. (4) Reclassify the brownfields to enhance their value. (5) Make a list of unutilized real estate and fit it into the city plan. (6) Adopt a team approach to enable developers and public participating in the planning process. (7) Cooperate with other cities, the provincial governments and the federal governments to make regulation rational and clarified and share successful experiences. (8) Establish a protection fund to support urban brownfields sites restoration and development program. (9) Redevelop brownfields by sensible development principles and integrate the economic, environmental and social benefits using triple-bottom-line approach. (10) Use sustainable dismantling and removal methods, including ecological restoration and building materials reuse.

3.0 POLICY RECOMMENDATIONS FOR SOIL MANAGEMENT IN CHINA

3.1 Confer on Soil Protection Fundamental National Policy Status

Fundamental National Policy in China is conferred on the most important policies for stabilizing society and the country. It is also the basic rule and guarantee for the existence and development of the country, as well as the basis for establishment of law, policy and plans. Given that soil is an irreplaceable resource it is recommended that soil be given Fundamental National Policy status.

Soil is unique amongst mediums of air and water, as it is an irreplaceable limited natural resource without which sustainable social and economic development is possible. Soil is the resource of life on the earth but soil fertility and structure continues to decline from increasing agricultural, forestry and animal husbandry activities. The formation and recovery of soil is long term, with new soil formed at an estimated rate of 1 centimetre over 300 years. Soil differs from air and water as it does not have the same ability to move or cleanse itself. When soil is polluted it becomes a root cause for ongoing long-term adverse effects on health, safety and the environment. Soil is limited in its area of coverage in China (mountain tops and deserts do not have soil) and good soil is even in less supply as the types of soil vary from location to location. Since soil forms slowly, is in limited areas with varying quality and under siege from economic development and agricultural overuse, the case for National Policy Status cannot be underestimated.

Soil is the growing medium for food, forest and agricultural crops. China needs good soil to feed its people which represents one-sixth of the world population, but has only 10 percent of the earth's total arable land. Ensuring clean soil, proper use of soil and rehabilitation of soil is a necessary precondition to food safety. The conferring on soil of Fundamental National Policy status is the first step in the guarantee for a safer food supply in China.

Soil has the ability to serve as a natural filter to transform chemicals that could adversely affect water, air and food and they contain an essential component of China's biodiversity and support and/or influence all the country's ecosystems. The complex movement, transformation and exchange of substances and energy are carried out between the soil and other biological species in the ecosystem, thus constituting a dynamic balance. The soil serves as a platform for the exchange of substance and energy between species and the environment.

Currently soil pollution in China from industrial, agricultural and commercial activities has not been effectively controlled. Soil pollution is not only a challenge for China but an international challenge as well. In 2014, the Ministry of Environment Protection and the Ministry of National Land and Resources jointly issued China's Bulletin of National Soil Pollution Circumstances Survey, which shows that the general condition of the nation's soil environment is not optimistic. Some areas are suffering from severe soil pollution including heavy metal contamination and the overloading of nutrients such as nitrogen.

The production and service capacities of soil, especially those of arable soil, have been degraded because of soil pollution. Soil is the basis for agriculture, industry and social service. Hence the capacity of soil is necessarily connected with the economic and social development. The production and service capacities of soil declined as the degradation of soil fertility from poor agricultural, forestry and animal husbandry activities became apparent.

The protection of soil will ensure China's capacity for sustainable and social development. Recognizing soil protection as a Fundamental National Policy is a guarantee for sustainable and social development of China.

3.2 Develop a comprehensive Soil Environment Protection Act, and gradually establish a regulatory system for soil pollution management based on this Act

It is a common and effective practice in many countries all over the world to protect the soil environment by developing and implementing laws and regulations. In China we note that the Standing Committee of 12th National People's Congress has listed the "Soil Pollution Prevention and Control Act" in its legislation agenda in order to set up a legal framework for soil pollution management. However, based on the international experience and China's specific problems with soil pollution, we believe that it is more appropriate to develop in China a more comprehensive "Soil Environment Protection Act" rather than a piece of legislation only about prevention and control of the pollution.

3.2.1 China's Soil Environment Protection Act must reflect China's soil reality.

The general situation of China's soil environment is revealed by the following numbers: 16.1% of the nation's soil is contaminated and 19.4% of arable land has been polluted. Further, soil pollution continues to worsen as it is not yet under effective control.

It is widely accepted that soil is the "basis of life and mother of all creatures". It is the most important material foundation to the survival and development of human's society, while in the

same time an indispensable strategic resource to the economic and social development of any nation. Once the soil is polluted, it will not only result in a degraded soil quality and directly influence agricultural, food security and human health, but will also generate other problems, such as water pollution, atmospheric pollution and the degradation of biodiversity. In the long term, this could influence the healthy balance of the whole ecosystem and threaten a country's environment security.

Over the past decade, along with China's rapid economic development, soil pollution has increasingly become a major problem and is developed in a worsening trend. Therefore, the basic and main objective in the coming soil legislation should be on the protection of clean land not yet polluted and the prevention of soil pollution and soil degradation by taking effective measures. Then the objective of repairing and restoring polluted soil follows.

China is a country with large populations where one sixth of the world's population should be fed. Because of this fact, it is the core and essential point of China's soil legislation to protect and improve the soil environment, especially by keeping the arable land in a good condition.

Also regarding to China's current soil environment situation, protecting the clean soil should be the priority of this legislation. This is a legislative position concluded in taking into account Chinese soil environment protection needs and soil pollution reality.

3.2.2 China's Soil Environment Protection Act must fit with the country's capacity to solve soil pollution problems.

The protection of soil environment indicates a scientific and appropriate way of using soil resource, in preventing any adverse impact on soil quality in the utilization process. The protection of soil means control of pollution from the very beginning, while the prevention and control of soil pollution means to prevent any pollution related to utilization activities of soil resource and to recover and repair soil that is already polluted by using technical measures.

China's soil pollution is currently at a dangerous level. Studies show that the ratio in the costs of proactive protection versus repairing the soil is 1:100. The investment that is needed to repair and recover soil is at least 100 times that of the initial investment that could have been made for proactive protection of the soil environment.

3.2.3 The recommendation of developing a Soil Environment Protection Act is because that the prevention of soil pollution should mainly be achieved by revising and improving other relevant environmental laws

Soil pollution indicates the phenomenon that by introducing physiological toxicity substances or an excess of plant nutrition into the soil, the properties of soil degrades or the plant physiological function of soil comes into disorder.

Soil pollution, mainly caused by human's inappropriate activities. Different situations will all cause soil pollution, such as toxic and dangerous waste water filters into the soil, harmful gas or floating dust fall into the soil with rainwater, solid waste dumped on the surface of soil. Preventing soil pollution, in the final analysis, is to prevent toxic and harmful water, solid waste and gas enter into the soil. Once these channels are blocked, the soil pollution will not occur. Thus the soil environment is protected.

According to what is said in the paragraph above, preventing soil pollution mainly concerns regulating behaviours of discharging polluting water, polluting gas and polluting solid waste. These behaviours are regulated under the Water Pollution Prevention and Control Law, Atmospheric Pollution Prevention and Control Law, Solid Waste Pollution Prevention and Control Law and other relevant environmental laws. To be clear, we should depend on these laws to regulate people's pollution discharge behaviours, so that the soil environment can also be protected. If the current laws on water, air and solid waste are properly drafted and implemented, China's soil environment should be in a much better condition. In that case, we may even not need a specific law on soil environment protection.

The prevention of soil pollution should mainly be achieved by revising and improving other relevant environmental laws such as Water Pollution Prevention and Control Law, Atmospheric Pollution Prevention and Control Law, Solid Waste Pollution Prevention and Control Law.

3.2.4 The recommendation of developing a Soil Environment Protection Act is based on the lessons learnt from other countries' soil environment legislative experience.

By looking at many examples of soil environmental laws abroad, most countries have used the name Soil Protection Law or Soil Environment Protection Law. Some examples include Soil Protection Law in Germany (1998), Soil Protection Law in Netherlands (1998), Soil Protection Law in Canada (1988), Soil Protection Law in British Columbia of Canada (1996), Soil Protection Law in Queensland of Australia (1986), Soil Protection Law in New South Wales of Australia (2004), Soil Protection Law in the Republic of Georgia (1994), Soil Environment Protection Law in South Korea (2004). There are also certain legislations that are addressed specifically to tackle soil pollution, for instance, Soil Protection Strategy Law in Japan (2002), Soil Pollution Law in Denmark (1999), the comprehensive act on environment, damages and

liabilities known as Superfund Act in the United States (1980) and Soil and Groundwater Pollution Control and Remediation Act in Taiwan District (2001).

The protection of soil environment is a key concept which covers comprehensively areas such as the protection of clean soil, the improvement of soil environment quality, the prevention of soil pollution, the risk management of polluted soil and remediation and recovery of polluted soil. A Soil Environment Protection Law, compared to Soil Pollution Prevention and Control Law, has an expanded scope and is more comprehensive in regulating the interrelationships that exist in the soil environment. A Soil Environment Protection Law is also more focused on proactively protecting the soil environment and is able to accommodate soil carbon and soil resiliency aspects especially as they relate to climate change.

Experts from Germany and Taiwan District of China who have participated in their soil legislation development all agree that a Soil Environment Protection Law reflects the new way of thinking where an integrated approach is taken. Soil Pollution Control and Remediation Law, Soil Pollution Remediation Law or Soil Pollution Prevention and Control Law are reflections of the past as they embrace the idea of reparation after damages have happened, with no ability to embrace emerging issues.

It is worth noticing that the notion of soil and the notion of soil environment is not the same concept. To be more precise in expression, using soil environment is more appropriate and precise in the relevant legislations.

3.3 Identify effective management framework for soil pollution management

Creating a clearly defined management framework is critical to the establishment of a national soil protection management system, for consensus building and joint effort of stakeholders.

A comprehensive and clear framework should be identified for strengthening and improving soil pollution management. We suggest that China should identify an effective management framework for soil pollution management as the following:



Figure 3-1 Framework on soil pollution management

3.3.1 A soil management framework that is consistent with the national vision for soil environment protection and reflects the comprehensive “Soil Environment Protection Act” is recommended to be established. Legislation is the precondition of the rule of law.

Till now, China has not yet established a systematic legal system on soil pollution management. Hence, the lack the legal basis for soil pollution management in China can easily lead to the arbitrary management among various administrative authorities.

It is the first task for China to develop a special soil act, and gradually establish a comprehensive legal system consisted of laws and regulations concerning soil pollution management. The legislation is the basis and guarantee for management.

Experience learnt from many developed countries shows that having a special soil protection Act, or soil pollution prevention Act is essential. These acts provide a legal basis for soil pollution management, as well as the guidelines and procedures for the authorities to manage the soil.

3.3.2 Safe soils for agriculture (with a focus on food safety) and the management of risks.

Based on the current situation and actual needs of China, two aspects should be identified as the priorities for soil management system development: the protection of clean soil, especially that of arable soil; and the risk management of contaminated sites. The emphasis of protection clean soil should be put on encouraging stakeholders to recognize the value of clean soil, and protecting clean soil through scientific methods and strict legal systems, especially for clean arable soil. Besides, the protection of clean soil should also involve the improvement of soil quality. While managing environmental risks from contaminated sites refers to assessing and control the environmental risks of contaminated sites through various ways.

3.3.3 Different measures should be taken in order to ensure the future of soil is protected, problems of the past are managed and have the flexibility to solve immediate problems.

From the perspective of soil pollution prevention, soil pollution management refers to three main issues: Legacy Site and Legacy Practice Action Program; Specific program on immediate response to imminent and substantial risks; and Policies to prevent further pollution of soils.

Legacy contamination is a very special problem which requires special principles and methods to address. The key to address legacy contamination is to establish a liability system and a financial mechanism. With regard to imminent and substantial risks, an emergency responding system should be established. Face with the further pollution of soils, soil legislation is essential in order to regulate activities of all the stakeholders.

3.3.4 The management system will define the tools: mechanisms enabling implementation; and enable institutional (including all stakeholders) capacity.

Law is not only for providing rules for behaviours, but also for creating conditions for the effective implementation of these rules, thus enabling the stakeholders to effectively comply with the laws and regulations.

Four aspects should be emphasized. The first is to establish an effective regime for soil pollution management and improve the management capacity. The second is to develop a standard system based on the high background value of soil and on the management of environmental risk, thus providing a basis for the strict implementation of legal systems concerning soil protection, management of environmental risk of soil contamination and soil remediation. The third is to establish a technical system for the remediation of contaminated sites and agricultural sites. The fourth is to an enabling mechanism which includes incentives for soil pollution management, to activate stakeholder participation.

3.4 Establish a scientific and integrated soil environment standard system and incorporate it into Soil Protection Act

The soil environment standard system is indispensable for the effective implementation of soil environment protection laws and regulations.

3.4.1 China needs to develop a comprehensive soil environment protection standard system.

The soil environment protection standard system should include soil environmental quality standards for agricultural land, risk based index on contaminated sites, technical standards and guidance on soil pollution investigation, sampling, evaluation and remediation, in order to meet urgent needs of soil environmental management in China.

In addition, the soil environment protection standard system should be designed using the primary principles of protecting human health, protecting continental and groundwater ecosystem; preventing soil pollution and the degradation of soil quality; separately establishing soil environment standards for agricultural land and land for development.

3.4.2 The soil environment protection standard system should be consisted of classified and regional soil environment standards, as well as national and local soil environment standards.

It is recommended that the principles of the system and the status of the standards be incorporated in the “*Soil Environment Protection Act*”. The methods for doing a site investigation and a risk assessment should be defined by the national government. The background values and the screening values should also be set by the national government. The national government should provide a guidance document for setting site specific target values. It is recommended to incorporate the methods and values in regulations underneath the “*Soil Environment Protection Act*”, because these methods and values need to be updated on a regular basis, as new insights and information about risks will become available.

Each province or region can then develop its own specific soil environment background value, using national uniformed technical requirements and methodologies. A national risk screening guideline should be developed for agricultural land and land for development, respectively, while provinces, municipalities and autonomous regions can develop more specific standards within the framework of national standards if needed. A national soil environment investigation, supervision, assessment and remediation technical standard should be developed, while provinces, municipalities and autonomous regions can develop their own standards in the framework of national standard. A national soil environment supervision guideline should be

development in order to clearly define the technical requirements for arranging the points, sampling, analytical test and quality control. Then, a national basic standard for soil environment, or a standard system for developing and revising standards, should be developed in order to define the terms, definitions and principles, styles, methods for developing and revising soil environment standards. Finally, technical guidelines should be developed for soil environment management, according to the actual development of soil environment standard system.

3.4.3 The principles of developing soil environment standard system in China.

There are three principles for developing soil environment standard system in China that should be considered. Firstly, the Chinese characteristics and the actual need for soil pollution management should be fully considered into the process of developing soil environment standard system. The emphasis should be put on two main problems: the safety of agricultural land and the contaminated sites which pose a threat to human health.

Secondly, the standard system should be developed in a systematic and scientific way. A comprehensive scientific soil environment protection standard system should include soil environment quality standard, soil environment quality assessment standard, standards for soil environment investigation, supervision, risk assessment and remediation, standard for analytical method, etc. Both international and national achievements in scientific research, and various investigation conclusion and data should be referenced.

Thirdly, limited and realizable objective should be set and a gradual improving process is needed for the establishment of soil environment standard system in China. The establishment of soil environment standard system is a long-term task which requires the development of a series of standards instead of a single standard number. Besides, the soil environment standard system should be in accordance with concerning laws, regulations and policies. Hence there should be a long-term plan covering the process of developing and revising the standards for the establishment of this whole standard system.

3.4.4 This standard system should be incorporated into the laws and regulations by clearly identifying its role and function for soil pollution management.

The standard for soil environment background value, soil pollution risk screening guidelines and remediation standard for specific sites should be clearly provided by the soil environment protection Act.

The standard for soil environment background value is important for the assessment of soil quality, the plan for soil environment protected area and setting up the objectives for soil environment protection. The soil pollution risk screening guidelines is the basis for soil investigation and risk assessment. The remediation standard for some specific sites is the basis for determining the scope and target for remediation.

3.5 Establish a fair and effective liability and financial mechanism to resolve legacy contamination

Many of China's soil pollution problems are at sites that have been contaminated in the past. The person or enterprise responsible for this historical contamination can be difficult to identify or find, may be no longer in business or lack the financial resources necessary to conduct a clean-up. This is a common problem in addressing legacy pollution in many developed countries worldwide, including the United States and Canada. In 1980, the United States enacted the Superfund Act specifically to tackle the issue of contamination at old, abandoned and uncontrolled sites. As China reinforces and improves its soil pollution management, it should be a priority to find appropriate solutions for these legacy contaminated sites. Otherwise, these historically contaminated lands can pose long-term environmental risks which not only threaten the country's ecological and environmental security, but also prevent these sites from being brought back into the economy through reuse and redevelopment. China's current piecemeal approach to legacy sites and its lack of a stable remediation funding source need to be addressed explicitly in any new soil legislation and policies.

3.5.1 The term "legacy contaminated sites" refers to sites that were polluted prior to enactment of a soil law or prior to a time specified in the law. As discussed above, the person or entity responsible for the contamination can sometimes be difficult to find or identify given the elapsed time. This poses a significant challenge for environmental protection of the soil and associated ground and surface water.

The existence of historical soil contamination problems is mainly due to the lack of an appropriate legal framework and management system at the time this pollution occurred. Therefore, certain specific measures must be taken to address these issues. The most important measure is for the Chinese government to establish both a clear liability mechanism to identify responsible parties for past, present and future contamination and a financial mechanism to support the remediation of legacy contaminated sites.

3.5.2 Establish a clear liability system in order to clarify the responsibilities for reparation and

remediation of legacy contaminated sites.

A comprehensive soil pollution law should include a clear identification of the individuals, entities, and enterprises that will be held liable for the remediation and/or costs of remediation of contaminated sites. Once these parties have been identified in the law, the law should also specify the scope of their legal obligations, or responsibilities, for correcting the problem either themselves or under government supervision, for funding someone else to do the clean-up and for any punitive damages. An effective liability system will both explicitly and clearly allocate legal responsibility of parties for all or part of the contamination found on a site. It will also delineate the party's specific responsibilities for land remediation.

In setting up its liability system, China should consider the full range of parties potentially responsible for legacy contaminated sites including: Generators of some or all the hazardous materials found at the site; Owners of the enterprises located at contaminated sites; Past and present operators of polluting enterprises; Transporters of hazardous materials to the site; Real estate developers; Financial institutions; Brokers; and Insurers, etc. Once responsible parties are established, the law should assign specific legal obligations to each or all of those parties for remediation and reparation.

The liability mechanism should contain provisions addressing the following situations : Where the polluter is clearly identified; Where the polluter is not clearly identified; Where the polluter is clearly identified but lacks the capacity to carry out the remediation of the polluted soil; Where the polluter can be identified but is either bankrupt or lacks the financial capacity to perform the remediation; and Sites requiring immediate remediation to address imminent and substantial threats to human health and the environment.

When setting up a liability mechanism for historical soil contamination, three issues, unique to China, should be taken into consideration: (1) China's land property system; (2) China's State-owned enterprises; and (3) China's current land tenure and land use regime together with the development of the real estate industry. These issues are the reality and specific circumstances of Chinese Society and cannot be ignored in designing a liability system.

The principle that should be followed in establishing a liability mechanism is the Polluter Pays Principle and the principle that whomever benefits from the land should compensate for the costs of remediation.

3.5.3 Create a fund dedicated to remediation and reparation of historically polluted sites

In addition to clarifying the responsibilities of relevant parties, a new soil law must address the issue of funding for remediation and reparation of legacy sites. The United States' experience with its legacy sites suggests that it is essential to create a dedicated fund for this purpose. China's soil remediation fund could be used for the clean-up of heavily contaminated, large-scale sites, or for the remediation of land intended for redevelopment, and/or for addressing important or urgent environmental risks generated by polluted sites.

The following issues should be considered when creating such a fund:

First, who should finance the fund? Should the revenue come from the Government's budget or that of enterprises? If the funding comes from the Government, it will be important to make clear the reasons that Government is providing the funding to justify it. If the funding comes from enterprises, it will be necessary to explain which companies are required to make contributions and why.

Second, it will be important to address the long-term stability and sustainability of the funding source(s). Experience shows that the remediation and reparation of legacy sites will not be achieved in a short time. China must be fully aware of the long-term character of this work, often over decades, making it necessary to consider the long-term stability and sustainability of the fund.

Third, how will the fund be used? This should include the use of the fund at both the national and local level. All uses of the fund should be regulated under clear criteria set forth in the law.

Fourth, what standards should be established for use of the fund? Are there limitations on or criteria for expenditures, timeframes for clean-up, types of clean-ups, appropriate scope of clean-up remedies, and when the fund can be used?

Fifth, how will the fund be managed and how will information about its utilization be made public? It will be important that the management and use of funds is transparent and done with appropriate involvement of stakeholders, communities and the public. Periodic publication of information regarding use of the fund should be required

3.5.4 Carry out investigation, classification and assessment of legacy contaminated sites in order to be prepared for the remediation and reparation of polluted soil.

In order to successfully carry out the remediation and reparation of polluted soil, it is necessary to carry out first a nationwide investigation on current polluted sites. Then classification of

polluted sites and environmental risk assessment could be carried out based on investigations. The sites to be remediated and recovered should be determined depending on the importance and urgency of the pollution.

The above work is fundamental. Thus this work should also be supported by the fund for remediation and recovery of legacy contaminated sites.

3.6 Establish an enabling mechanism which includes incentives and a series of measures for soil pollution management, to activate stakeholder participation

The management of soil pollution does not only refer to the approaches for legislation, enforcement and judiciary, but also refer to auxiliary conditions for the effective implementation of laws and regulations, for example, the incentive mechanism. The incentive mechanism is indispensable for soil pollution management, since soil pollution management is not aimed at punishment, but at encouraging and enabling the participation of the governments, enterprises and citizens for soil environment protection and soil pollution prevention.

China should take multiple incentive measures such as government guidance, economic incentives and public participation to encourage more active participation of government, enterprises, other social groups and individuals in soil environment protection and pollution control and more innovative cooperation between governments, enterprises and society. A cooperative relationship will help resolve the difficulties that exist in the market of soil remediation. It will also promote an urban and regional revitalization and sustainable development.

3.6.1 Government guided incentive mechanisms and measures

The redevelopment plan for contaminated sites is an important part of national planning system. By developing and publishing redevelopment and remediation plans for the contaminated sites, we should try to implement the policies of “who invests in remediation takes the benefit” and “who remediates the land takes the privilege of redevelopment” to stimulate land redevelopment process and encourage investment from enterprises and society into the soil remediation. This could not only promote a healthy redevelopment of polluted sites but also stimulates the economy and creates more job opportunities.

Unlike the treatment of other types of pollution, the remediation of soil pollution is closely related to its future redevelopment and reuse activities. This needs soil management policies and laws that allow and encourage the cooperation of polluters, remediate, redeveloper and other

interest parties. Establishing and improving incentive mechanisms and incentive measures reflects the emerging trend of modern soil pollution management.

Unlike the treatment of air and water pollution, the remediation of soil pollution is closely related to its future redevelopment and reuse activities. This needs soil management policies and laws that allow and encourage the cooperation of polluters, remediate, redeveloper and other interest parties. The central and local government should encourage a “wise development”, using land in a high-density and cost-effective way and try to implement a principle of “the most effective utilization”.

It is recommended that a defined four step process that follows a plan, study, remediate and develop approach be established to guide the redevelopment of any contaminated sites at the national. Sub national or local levels. All stakeholders involved in the four step process from government agencies, insurers, financial institutions, developers, consultants and others will be deemed accountable for actions they are assigned responsibility for within the process. This will include but not be limited to assessing the site for contamination, identifying the regulatory requirements for site safety and clean up, developing and carrying out the appropriate remediation or risk management plans, reassessing the site and if needed implementing an ongoing monitoring plan.

Setting up Soil Bank to protect clean soil in the process of development and urbanization. A soil bank should be established at the subnational and local level to ensure all soil is saved for future use. Creating a Soil Bank means taking the soil from the original site during a development activity and stores it in a certain area according to its classification, or in another situation, store the contaminated soil on site which cannot be used and provide it to different land user for storage, exchange or development.

The establishment of Soil Bank can help protect the clean soil, promote conservative and effective use of soil resource and increase the possibility of cultivation. In order to develop the Soil Bank regime, the central and local governments should support and encourage the creation of soil storage sites, create and develop soil exchange market and provide relevant information services. Financial and technical support should be given to the reuse of polluted soil in the Soil Bank after its remediation.

3.6.2 Economic incentive mechanism and measures

The economic incentive mechanism and measures should be included into the system of Natural Resource Accounting. Soil is an important natural resource, as well as key environmental

elements. In the framework of institutional reform of ecological civilization, the economic value of soil should be integrated into the system of Natural Resource Accounting and the system of Natural Resource Damage Accounting.

Encourage and support the establishment of various types of soil protection fund in order to support soil environment protection. The sources of the state soil environment protection fund could include revenue of a special tax in industries with high soil pollution risks and relevant budget. For instance, the Superfund Act in the United States taxes the oil and gas industry, India takes 2% of GDP to this fund. The fund also welcomes social donations. The country gives awards to the regions which achieves effective protection and improvement of agricultural soil quality.

Several financial instruments are recommended to be developed specifically for those sites that are candidates for redevelopment. Tax incentives and waiving of governmental fees should be established at the national and subnational levels to serve as a catalyst for cleanup. This includes those that invest in remediation, share in any financial return. Grants for environmental and feasibility studies should be made available for those that need financial support and meet qualifying criteria for site redevelopment. Rezoning of land use to raise rehabilitated contaminated site value is another option recommended based on fit for use results from the site specific risk assessment undertaken.

Encourage and support the scientific research and technical application of soil pollution management. The lack of developed soil remediation industry and relevant techniques is an important and fundamental reason that hampers the development of soil remediation market. In many places, remediation of soil depends on foreign personnel and techniques. The scientific research, technical development, application and promotion of China's soil pollution prevention and control are all at an early stage of development. Thus they needs support, guidance and stimulation from the economic policies. It's necessary to take fiscal funds supporting, tax, price and credit and loans to support the scientific research, technical development, application and promotion. It is important to establish key regional pollution control technology integrated demonstration area. It is also necessary to select key area of soil pollution prevention and control and establish big-scale soil risk monitoring and remediation demonstration area, in the objective of achieving safe utilization of agricultural land.

It is recommended that a quality assurance process be adopted that covers all stakeholders involved in the process of site identification, classification, characterization, remediation and monitoring to ensure the integrity of the soil environmental management process. This includes

but is not limited to: recognized professional status (ex. engineering, science, law, business); current license to practice (degrees/diplomas/professional certifications) associate; quality assurance certifications for all laboratories undertaking analyses; personal sign off accountability for site characterization, remediation, monitoring reports and data submissions; transport system and technology vendor certifications

Offer financial aid and technical guidance for the investigation and assessment of soil. The investigation and assessment of soil pollution have high scientific requirements, but are very important to the scientific and rational reuse of soil being remediated. We should make technical, economic and industry policies to support the development of soil pollution investigation, assessment and remediation service organizations. To the companies that actively take the initiative to investigate and assess soil pollution, some financial aid and technical guidance should be given.

3.6.3 A clear encouragement of organic agriculture: the country should grant subsidies to companies producing organic fertilizer, slow-release fertilizer and low-toxic high-efficiency pesticide and biological pesticide and fertilizer. Subsidy and technical assistance policy will encourage and guide agriculture land user to adopt more organic fertilizer and biological techniques to prevent agricultural diseases and improve soil quality.

A clear encouragement to reduce fertilizer, pesticide and other substances use in agriculture: the government should increase financial support and organize periodical workshop to guide farmers and agricultural producers to properly use pesticide, fertilizer and agricultural film, so that the soil environment can be protected and improved.

Encourage the farmers and other agricultural producers to adopt measures such as the combination of planting and breeding and crop rotation, to protect soil environment. Give some proper compensation to the farmers and agricultural producers who suffer loss from this activity.

3.6.4 Public access to and distribution of all relevant information to all affected stakeholders regarding the status of soil and its potential impact on their health, safety or surrounding environment.

The right to know, the right to be heard and the right of appeal by stakeholders are proven in international experience to be one of the best ways to ensure a proper solution is identified and implemented. Traditional environmental management takes a command and control mode, while modern soil pollution management involves ideas of pro-activeness, service orientation and effectiveness, with more emphasis on enabling to get more public participation.

Governments, companies and other organizations should publish soil environment information concerning soil and accept public scrutiny. The exchange and release of soil environment information is critically important to the formation of a cooperative pattern among governments, companies and society, as it is the foundation of that cooperation. In the same time, the release of information helps answers the questions that the public may have concerning soil pollution and answer the needs of the public on anticipated land use. We should use multiple methods to facilitate access to information of soil environment to the public, including government information and private enterprise information. We should also be serious in gathering the public's opinions and encourage enterprises, individuals, especially the ones that are influenced by soil pollution to exchange their ideas.

Open channels for complaints and reports from the public on soil pollution behaviors. By establishing and improving public participation mechanism, encouraging the public to participate in soil protection, urging companies to fulfill soil remediation obligations, guaranteeing the rights of organizations and individuals to make complaints and litigation, soil pollution prevention and control can better cater the need for economic and social developments.

