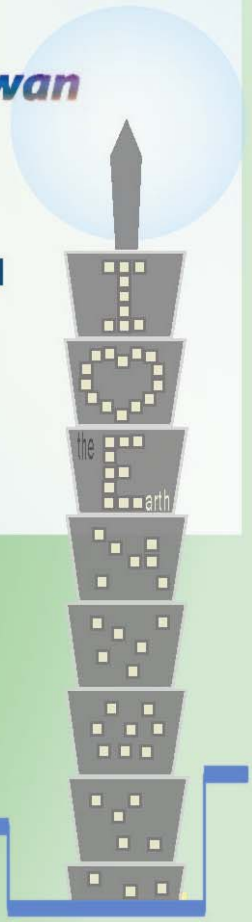
June 14, 2011

Conference on Human Health Risk Assessment of Soil and Groundwater Contaminated Sites

Taipei, Taiwan

R401, 4F,
National Taiwan University Hospital
International Convention Center
ROC (Taiwan)



Proceedings

- Environmental Protection Administration, ROC
- United States Environmental Protection Agency
- Taiwan Association of Soil and Groundwater Environmental Protection
- Working Group of East and Southeastern Asian Countries on Soil and Groundwater Pollution and Remediation

Preface

We found that the goals of Taiwan EPA future work were to clean up the contaminated land with green remediation strategies, protecting our resources by rigorously carrying out the regulations, provide training courses of advance technologies for our professionals, and share our experiences with other countries, especially for Asian countries. What is the remediation goal of the pollutants of the contaminated sites are a hot issue to be discussed in many sites of the world? We can find there are different regulations to be followed in contaminated sites for different countries, in terms of one target value in soil, the soluble or bioavailable concentration in soil solution, or risk-based approach concentration of the pollutants in soil and groundwater system of the sites. Finally, we must use the remediation techniques by health risk-based approach method to create the remediation goal because we do not have enough budgets, time or techniques for different status of the pollutants in the contaminated site.

The primary objectives of this working group on human health risk assessment are to provide different case studies on the methods and modeling of human health risk assessment of different pollutants in the different sites. In the first session, we invited three experts, Dr. Haluk Ozkaynak, Dr. Karen Bradham, and Dr. Paloma Beamer, from USEPA to share their experience and we hope it can be applied in the contaminated sites of the Asian countries in the future.

In the second session of the workshop, we invite Dr. Chih Huang to present the case study on the human health risk assessment for contaminated sites management in Taiwan. We also invite Dr. Tomoyuki Makino from Japan and an expert from Korea to share their experience on the risk assessment methods for heavy metals contamination in soil and crops.

In the last session, we invite Dr. Pey-Horng Liu to share one case study on the contamination forensics and post treatment planning of a site located at the southern Taiwan. We also invite all the participants from Asian countries to share their opinion on the different contamination conditions occurred in the sites in this region. We understand the important of the education and communication of the human health risk assessment for the people community exposure in a contamination site. We know that the risk-based approach remediation techniques should be a very important direction to be followed to develop different remediation techniques for soil and groundwater contaminated sites in the world, especially in the Asian countries.

Chairman of the Working Group
Zueng-Sang Chen, Ph.D., signed on June 7, 2011

Distinguished Professor and Associate Dean
Department of Agricultural Chemistry
National Taiwan University, Taipei 10617, TAIWAN
Email: soilchen@ntu.edu.tw

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Agenda

Time	Topic	Speaker
08:30-09:10	Registration	
09:10-09:20	Opening Ceremony	Dr. Zueng-Sang Chen
09:20-10:00	Keynote Speech: Sustainable Land Management in Taiwan - The Past and The Future	Mr. Hung-Teh Tsai
10:00-10:30	Break	
10:30-11:10	Assessing Children's Multimedia/Multipathway Exposures and Risks to Environmental Chemicals & Residential and Contaminated Soils	Dr. Halûk Özkaynak and Dr. Karen Bradham
11:10-11:40	Collection and Uses of Activity Patterns for Risk Assessment Modeling	Dr. Paloma Beamer
11:40-13:00	Lunch	
13:00-13:30	Human Health Risk Assessment for Contaminated Site Management in Taiwan	Dr. Chih Huang
13:30-14:00	Risk Alleviation Methods to Heavy Metal Contamination in Soils and Crops: Research Development in Japan	Dr. Tomoyuki Makino
14:00-14:30	Case Studies and Experiments in Korea	
14:30-14:50	Break	
14:50-15:20	Contamination Forensics and Post-treatment Planning of the Dapingding Site	Dr. Pey-Horng Liu
15:20-16:20	Case Studies and Experiments on Soil and Groundwater Pollution and Remediation: Korea and Japan	Dr. Jae Eui Yang and Mr. Masanori Kobayashi
16:20-16:40	Discussion	
16:40-16:50	Closing Remark	Mr. Hung-Teh Tsai

Conference on

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Invited Speakers

Mr. Hung-Teh Tsai (Taiwan)

Dr. Halûk Özkaynak (USEPA)

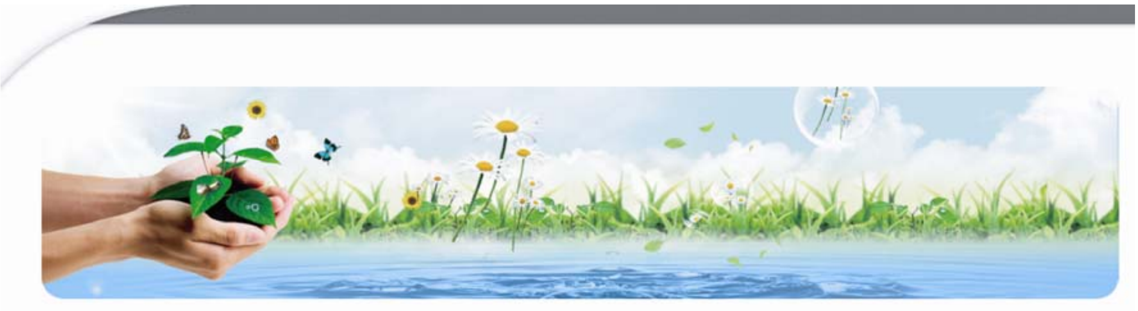
Dr. Karen Bradham (USEPA)

Dr. Paloma Beamer (USEPA)

Dr. Chih Huang (Taiwan)

Dr. Tomoyuki Makino (Japan)

Dr. Pey-Horng Liu (Taiwan)



Mr. Hung-Teh Tsai

Education

- M.S. in Environmental Engineering, National Taiwan University
- B.S. in Public Health, National Taiwan University

He is Technical Superintendant and Executive Secretary in Soil and Groundwater Remediation Fund Management Board (SGRFMB), Environmental Protection Administration, R.O.C.He has many experiences in Administration, Site Supervision and Management.

Dr. Halûk Özkaynak

Dr. Halûk Özkaynak is the scientist of USEPA Office of Research and Development, National Exposure Research Laboratory, RTP, NC. And was the professor of Harvard School of Public Health. The title of the presentation is Assessing Multimedia/Multipathway Exposures and Risks to Environmental Chemicals. USEPA and many agencies in the US and other countries rely upon risk assessment methodologies for setting standards, conducting community health or epidemiologic studies to estimate pollutant-specific risk estimates for general and sensitive sub-populations. These assessments are used to ascertain the likelihood of health impacts posed to populations of concern, as well as support environmental regulations or help determine optimum/cost-effective risk mitigation strategies. This presentation will briefly describe some of these quantitative tools or models used for assessing human exposures and risks to environmental chemicals, in particular, special sensitive subgroups that include children. The methodologies used incorporate various sources of information. The presentation using quantitative tools or models to ascertain the likelihood of health impacts posed to populations of concern.

Dr. Karen Bradham

Education

- Ph.D. in Environmental Toxicology, 2002, Oklahoma State University
- M.S. in Chemistry, 1999, Western Carolina University
- B.S. in Chemistry, 1997, St. Andrews College

Karen Bradham is the Scientist of USEPA Office of Research and Development, National Exposure Research Laboratory, RTP, NC. This presentation will include details on assessing soil contamination impacts on human health. USEPA methods used to investigate residential and contaminated soil sites will be presented. This presentation will include information on the importance of bioavailability and USEPA's Bioavailability Guidance for use in human health risk assessment. Sampling methods and a summary of the American Healthy Homes Survey will be provided to highlight lessons learned from a national survey of residential related hazards.

Dr. Paloma Beamer

Education

- Ph.D., 2007, Civil and Environmental Engineering, Stanford University
- M.S., 2002, Civil and Environmental Engineering, Stanford University
- B.S., 2000, Civil and Environmental Engineering, University of California, Berkeley

Dr. Paloma Beamer's research investigates indoor contaminants (dust) contributed by either the tracking in of contaminated soil or from the infiltration of airborne particulates. She and her Public Health colleague, Dr. David Layton, have developed computer models to characterize the transport of soil and particulates into residences and their disposition once inside. Among their findings from a study of households in the Midwest was that ambient air could account for nearly 60% of the As input to floor dust, with the remainder coming from the tracking in of soil. They did find that over 80% of the As bearing floor dust could be removed by cleaning.

Dr. Chih Huang

He is the vice president of Sinotech Engineering Consultants, Inc. He has many experiences in Ground Water Science, Environmental Site Assessment, and Remediation Planning, Design, Construction, and Operation of Remediation Work.

Dr. Tomoyuki Makino

Education

- Ph.D. in Agriculture, 2000, Tohoku University
- M.S. in Agriculture, 1990, Tohoku University
- B.S. in Agriculture, 1988, Tohoku University

He is the Leader of Research Project for Risk Management of Hazardous Chemicals, National Institute for Agro-Environmental Sciences. He has been the Leader of Research Project for Risk Management of Hazardous Chemicals, National Institute for Agro-Environmental Sciences. Major research interests are Environmental contamination and remediation and Soil Chemistry.

Dr. Pey-Horng Liu

Education

- Ph.D. in Chemistry,1994, National Tsing Hua University
- M.S. in Chemistry, 1985, National Tsing Hua University

He is the manager of Introduction of Green Energy and Environment Research Laboratory, Industrial Technology Research Institute. He has many experiences in Remediation Planning, Design, Construction, and Operation of Remediation Work.

Sustainable Land Management in Taiwan - The Past and The Future

Hung-Teh Tsai

Executive Secretary, Soil and Groundwater Remediation Fund Management Board
Environmental Protection Administration, Executive Yuan, Taipei, Taiwan, R.O.C.

Abstract

Soil and groundwater are both the valuable nature resources and the foundations for living and development. Once the land is contaminated, not only harm to environment and humen may occur, the value of the land and the economy of the country may be affected in a negative way as well. Since the establishment of Taiwan Environmental Protection Administration (TWEPA) in 1987, the increasing incidents of soil and groundwater contamination resulted in a sense of urgency in managing the soil and groundwater contamination with a proper manner. Therefore, the Soil and Groundwater Pollution Remediation Act (SGPRA) was drafted in 1991 and promuglated in 2000. Over a decade's endeavor, TWEPA has established a sound and complete contamiated site management legal framework. While the process was not a smooth ride and the bettering effort is still in demand, the experience is worth sharing among the people concening the challenges in soil and groundwater protection in the global society.

This work will focus on the history and the future evolution of soil and groundwater protection in the prospective of TWEPA. The introduction of legal framework and the accomplishment in discovering and solving the environmental problems for the past ten years are presented. Given the lessons learned by the authority, TWEPA is determining to integrate the sustainable land use and contaminated land revitalization concepts within the SGPRA. However, challenges faced are never easy. TWEPA foresees the challenges and strategic roadmaps are required. On the other hand, TWEPA believes collective knowledge and international collaboration are the best way to achieve the common goals. Consequently, TWEPA will dedicate itself to assisting the regional countries for the interest of regional development and sustainable environment.

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Environmental Protection Administration
Executive Yuan, R.O.C.

Sustainable Land Management in Taiwan - The Past and The Future

Hung-Teh Tsai, Executive Secretary

Soil and Groundwater Remediation Fund Management Board
Environmental Protection Administration
Executive Yuan, Taiwan, R.O.C.

Outline

- The Beginning
- Site Management Concept and Policy
- Accomplishment
- The Future
- Conclusions

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The Cause

The Beginning

- Soil and groundwater contamination has become a major environmental issue in Taiwan since 1980's
- Environmental Incidents like Taoyuan RCA and Tainan Anshun reveal the urgency of proper soil and groundwater contamination management

Legislation Effort

The Beginning

1991
- **Soil Pollution Prevention Act** first drafted

1996
- Cadmium Rice Incident
- Petroleum Contamination occurrence
- RCA Groundwater TCE Contamination
- Agricultural Land Contamination

1996–1998
- **Soil Pollution Prevention Act** withdrawn from Legislation Yuan

1998
- Revised the liability, funding source, and land management related framework

1999
- Resubmitted as the **Soil Pollution Remediation Act** to Legislation Yuan
- Requiring the linkage between soil and groundwater contamination

2000
- **The Soil and Groundwater Pollution Remediation Act (SGPRA)** passes

Regulatory Basis

Site Management Concept and Policy

- SGPRA was created for the purposes of preventing and remediating soil and groundwater contamination
- Measures in SGPRA
  - Prevention
  - Site investigation and assessment
  - Contamination control
  - Remediation
  - Liability
  - Fine and legal responsibility

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Regulatory Basis

Site Management Concept and Policy

- Regulated substances

Monitoring Standards

- Heavy metals
- General items
  - Hardness
  - Total Dissolved Solids
  - Chloride
  - Ammonia
  - Nitrates
  - Sulfates
  - Total Organic Carbon

defining potential

Control Standards

- Monocyclic aromatic hydrocarbons
- Polycyclic aromatic hydrocarbons
- Chlorinated hydrocarbons
- Agricultural Chemicals
- Heavy metals
- General items
  - Nitrates
  - Nitrite
- TPH and Cyanide

defining contamination

The Monitoring Standards serves as early warning to The Control Standards

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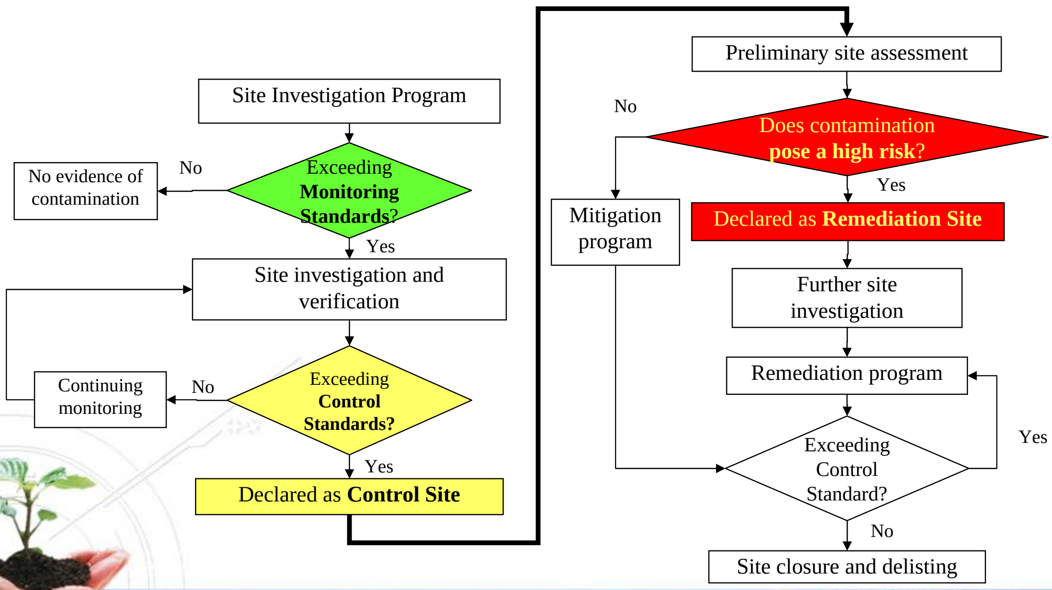
Regulatory Basis

Site Management Concept and Policy

- Dual-Threshold Management Framework



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Regulatory Basis

Site Management Concept and Policy

- The act has proactively offered a legal pathway for contaminated land revitalization and redevelopment within the framework
- For a Remediation Site
  - Risk-based remediation goal is allowed IF
    - Technical Inpracticalbility (TI) exists
    - Land redevelopment is intended

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Regulatory Basis

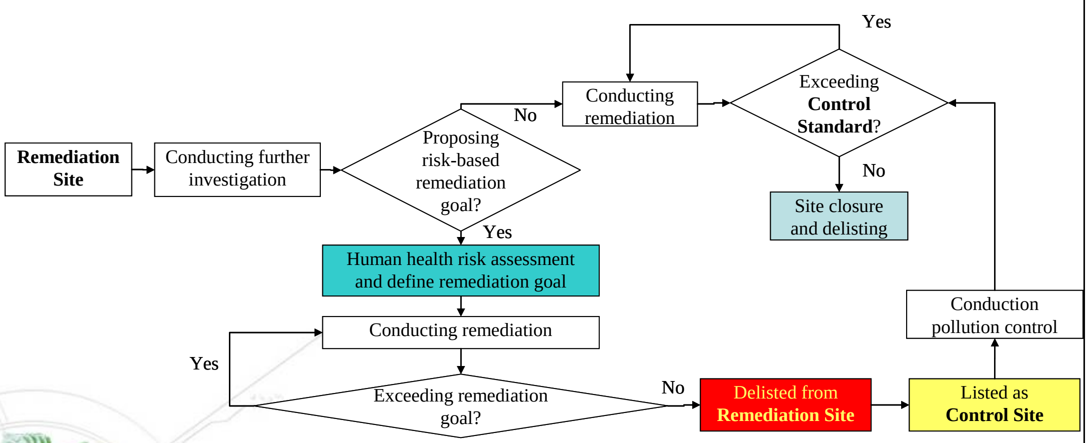
The Beginning

- Responsible parties
  - Land owner
  - Polluter
  - Potential responsible party
- Source of funding
  - Remediation fee collection
    - chemical substance manufacturers and importers designated by the central competent authority
  - Government budget

Risk-based Remediation

Site Management Concept and Policy

- Designed mainly for the Remediation Sites



Land Redevelopment

Site Management Concept and Policy

- Responsible parties may propose risk-based remediation goal based on risk assessment for future land use
- If the land is intended for redevelopment, the redevelopment plan shall be submitted along with the remediation program for review
- The remediation program and the suitable monitoring program after redevelopment then can be overseen

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Strategy

Accomplishment

- **Knowing the problems and challenges**
  - comprehensive site investigation
- **Learning from experience**
  - continuing improvement of regulations and policy framework
  - sustainable land management
  - transition to risk-based environmental policy
  - advocating international collaboration

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Strategy

Accomplishment

- **Realizing the policy**
  - guidelines for citizens
  - training and certification programs for related professions
- **Research and development**
  - annual research program
  - interagency research program (e.g., exposure related parameters)

Site Investigation

Accomplishment

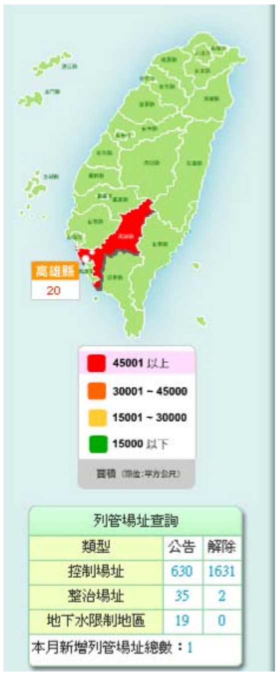
- Knowing the contamination through comprehensive site investigation programs
  - Agricultural land
  - Gas stations and petro tank farms
  - Abandoned and not-in-operation factories
  - Factories with high potential of DNAPL contamination
  - Military bases and airports



Site Investigation

Accomplishment

- Current status
  - 630 Control Sites
  - 35 Remediation Sites
  - Declared contaminated area is over 900 ha
- Delisted history
  - 1631 Control Sites (mostly agricultural land)
  - 2 Remediation Sites



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Remediation

Accomplishment

- Variety of remediation technologies have been employed
- *In-situ* remediation technologies are the most utilized
- *Ex-situ* treatment mainly used for source zone soil treatment (thermal and soil washing)

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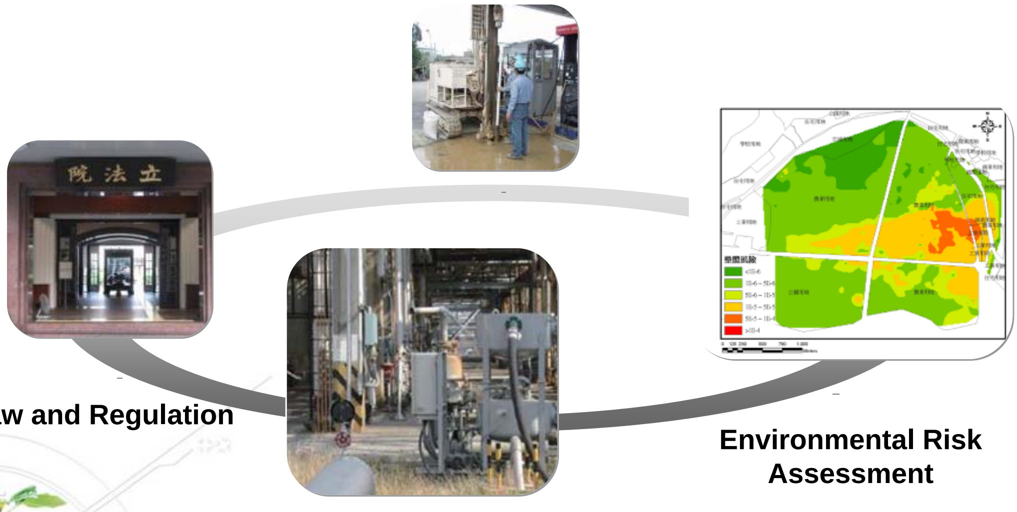
Guidelines for Citizens

Accomplishment



International Collaboration

Accomplishment

- Regular annual workshop held with USEPA
  - Exchange technical information
  - Workshops and advisory in technology development and policy enhancement
- Cooperation MOU through private sectors
  - CL:AIRE
  - Defra / Environmental Agency (in negotiation)
- Asian regional forum and task force

• Creating international gateways and platforms
• Being responsible as a global member

Related Policy in Development

The Future

- Continuing implementing environmental risk assessment
- Human health risk assessment has become the critical element in the contaminated sites management since the enforcement of the SGPRA
- The human health risk assessment guideline has been implemented in 2005, while an ecological assessment guideline is expected to be established in 2013
- The environmental risk assessment will continue to evolve and becomes the foundation of contaminated site management protocols

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Related Policy in Development

The Future

- Contaminated Land Revitalization Program (CLRP)
  - Sustainable use of land is recognized as a critical issue to Taiwan
  - CLRP will be a vehicle for solving contaminated land issues and turning contaminated sites from debt to profit to Taiwan.
  - The initial framework is expected to be completed in 2012
  - The construction of low carbon community is an excellent demonstration of synergy which a contaminated land revitalization program can provide

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Related Policy in Development

The Future

- Contaminated Land Revitalization Program (CLRP)
  - Strategy for realization of CLRP
    - integration of existing regulations and laws to shorten the time to practice
    - Real life case demonstration

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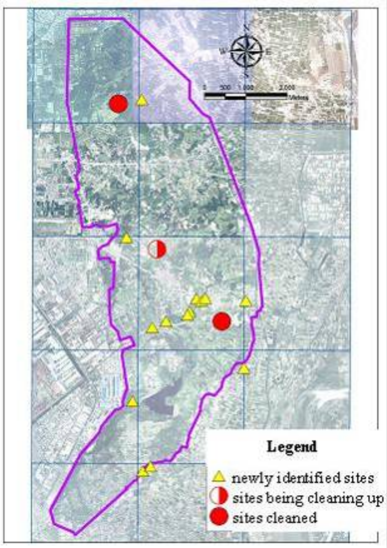
Candidate sites for CLRP

The Future

- The area of the DPDSD Site is over 3,000 ha. and the site has been a place for illegal dumping of industrial waste in the past
- Given the scale and level of contamination, TWEPA plans to look beyond the environmental issues and embrace the concept of redevelopment as an EcoTown.



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Candidate sites for CLRP

The Future

- The site was declared as a historical site in 2007. However, it is heavily contaminated with heavy metals (mainly Hg, Cu, and As).
- The area of the FTMMC Site is around 36 ha. and adjacent to the area of Jiguashi Histrotical Site Development Project. The FTMMC Site becomes a feasible site for contaminated site redevelopment

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International Effort

The Future

- TWEPA is committed to become the hub for regional countries to acquire information and knowledge about subsurface environment protection. Advancing technologies and market collaborations are expected benefits to regional development
- Continuing to expand the cooperation relationship with developed as well as emerging countries including governmental and private sectors

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Conclusions

Conclusions

- The soil and groundwater protection in Taiwan will continue to evolve and will be the major issue in the future
- Contamination site management will not limited to remediation but shall extend to sustainable land use and contaminated sites revitalization
- TWEPA is dedicated to international collaboration and will strive for more intimate cooperation relationship with regional countries to progress the knowledge in a collective manner

Thank you for your attention

Human Health Risk Assessment for Contaminated Site Management in Taiwan

Chih Huang
Senior Research and Deputy Manager
Environmental Engineering Research Center,
Sinotech Engineering Consultants, Inc.,
Nei-Hu, Taipei, Taiwan, R.O.C.
chih@sinotech.org.tw

Abstract

The Legislative Yuan granted the Soil and Groundwater Pollution Remediation Act (SGPRA) in 2000 to address the concerns to the subsurface contamination. In the body of the act, human health risk assessment (HHRA) have been integrated for contaminated site management. While the risk-based policy, site assessment, and remediation decision making are recognized as vital protocols to the contaminated site management, the realization of such frameworks have been proven to be a demanding task. Over a decade, Taiwan Environmental Protection Administration (TWEPA) has been establishing guidelines, by-law, and regulations to practice the concept of risk-based contamination site management. While the outcomes are satisfactory, the application of human health risk assessment in soil and groundwater contamination management needs further endeavour.

The aim of this study is to provide an overview to the progress in practicing risk-based site management framework in Taiwan. The main issues discussed include the regulatory framework, available guidelines, and the long term development. In the early phase, HHRA was used for assessing the severity of the Control Site to determine whether the Remediation Site should be declared. The limited application has helped the authority to better understand the probable hurdle and to make progressive improvement to the risk-based policy as well as administrative protocol (e.g, guidelines). As the systematic evolution continues, there are several challenges worth mentioned. The challenges include the communication to stakeholders (e.g., public, authority, and environmental profession), smoother administrative procedure, and the linkage with sustainable land management. To take on the challenges, a risk-based site management development roadmap is proposed. In particular, the connection between HHRA or environmental risk assessment to the sustainble development is emphasized in the roadmap. The presentation of this study intends to provide the Taiwan experience in applying HHRA to contaminated site management and future vision of related policy so that lessons learned can be helpful to the regional and global partners.

East and Southeast Asia Working Group in Soil and Groundwater Remediation

2011 International Conference on Human Health Risk Assessment for Soil and Groundwater Contaminated Sites

Human Health Risk Assessment for Contaminated Sites in Taiwan

Chih Huang, Ph.D., PMP
Senior Researcher and Deputy Manager
Environmental Engineering Research Center
Sinotech Engineering Consultants, Inc.

June 14, 2011

Outline

- Initiation of risk assessment
- Human health risk assessment framework
- Issues regarding the application
- Future development

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Initiation of risk assessment

Regulatory Aspects

- 「Soil and Groundwater Pollution Remediation Act」(SGPRA) was promulgated in February 2000 and revised in 2010
- SGPRA Article 24
  - … unable to lower the pollutant concentrations below the groundwater pollution control standards by remediation because of factors such as geological conditions, pollutant properties or contamination remediation technologies may submit a remediation target for groundwater pollution based upon environmental impact and assessment of health risks.
  - If the land within a remediation site is to be utilized for land development, the soil pollution or the groundwater pollution remediation standards or targets may be specially approved by the central competent authority after consulting with the relevant agencies.

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Initiation of risk assessment

Regulatory Aspects

- SGPRA Article 12
  - The Control Site shall be assessed with a preliminary assessment protocol to determine if the site poses severe harm to public and environment.

Soil and Groundwater Pollution Control Site Preliminary Assessment Regulations

- Exceeding 20 folds of the Control Standard
- May conduct a human health risk assessment

Early adoption of human health risk assessment protocol by preliminary assessment offered chances to discover the potential obstacles and policy polishing

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Initiation of risk assessment

Guidelines and Assessment Tool

- Human Health Risk Assessment Guideline was published in 2005 and revision is expected to go public in 2011
- TWEPA has implemented a Human Health Risk Assessment Simulation System for assessors and interested parties to conduct the assessment

http://sgw.epa.gov.tw/HRisk2010/

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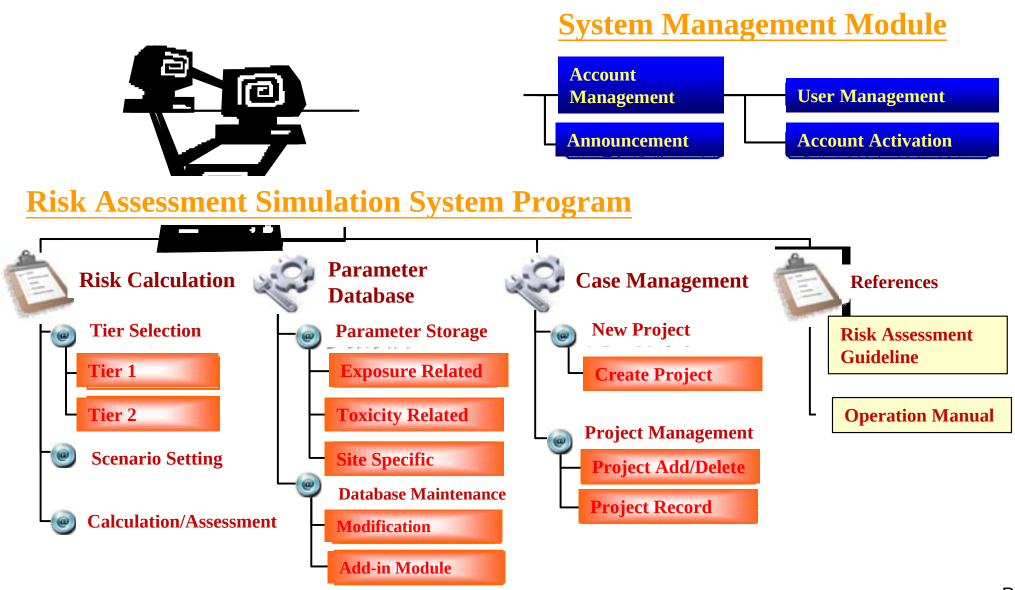
Initiation of risk assessment

Risk Assessment Simulation System



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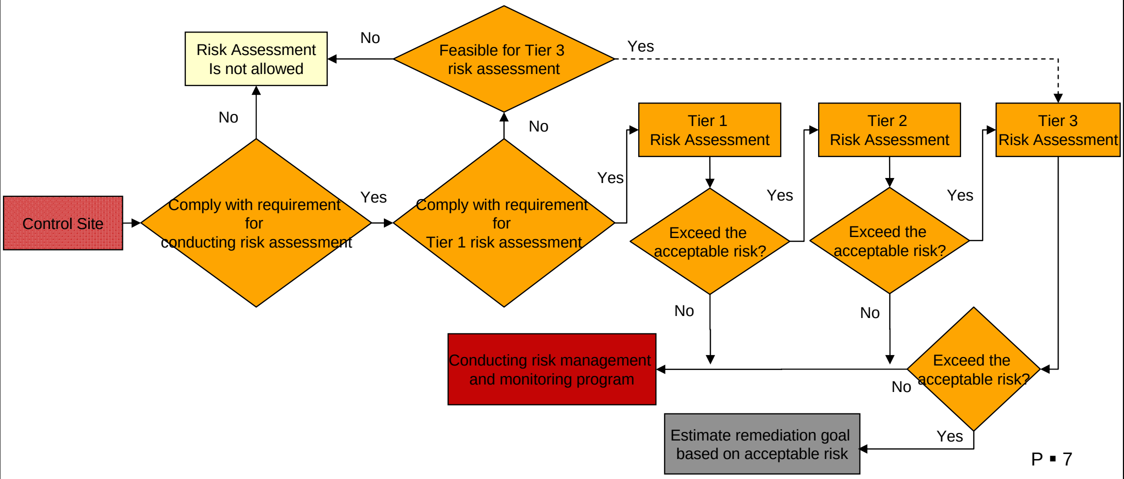
Human Health Risk Assessment Framework

- Based on the ASTM Method E 1739-95
- Tiered approach



Human Health Risk Assessment Framework

Tier 1
- Default scenarios and parameter
- Exposure parameter fixed

Tier 2
- Default scenario
- Parameter adjustable

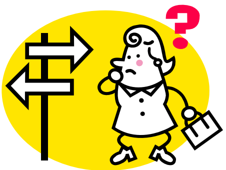
Tier 3
- Non-default scenarios
- Parameter adjustable
- Transport model selectable
- Food chain

The scenarios and exposure parameter in tiered approach：

- Tier 1: TWO scenarios and all default values for assessment
- Tier 2: TWO scenarios, all default values for exposure parameters, and hydro and geo parameters from site investigation
- Tier 3: Scenarios and parameters are opened to assessor, transport model can be defined by users

Human Health Risk Assessment Framework

- Prior to the assessment
  - Immediate harm or acute
  - Bioaccumulation
  - Ecological concerns
  - Indirect exposure pathway
  - Other than residential or commercial area



Define objectives and assessment level

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Human Health Risk Assessment Methodology

Hazard Identification
- COPC
- Scope of Assessment

Dose Response Assessment
- Toxicity factor
- SF and RfD

Exposure Assessment
- Site Conceptual Model
- Fate and Transport
- Intake

Risk Characterization
- Carcinogenic Risk
- Non-Carcinogenic Hazard
- Uncertainty Analysis

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Issues regarding the application

- Localization of parameters
  - Geological、Receptor、Toxicity
    - Investigation
    - Referring
    - Inferring
  - Review process
    - Determining the suitability of the default parameter values
  - Integrating the existing database
    - Geological
    - Receptor related

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Issues regarding the application

- Scenario setting
  - Exclusion of Pathway
  - New pathway needed
  - Receptor related
  - Land use related
- Tier selection
  - cost
  - Involving food chain

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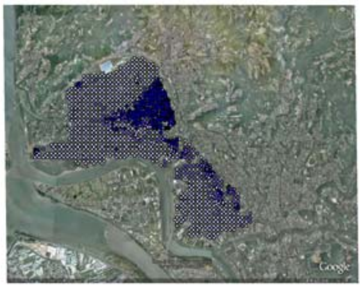
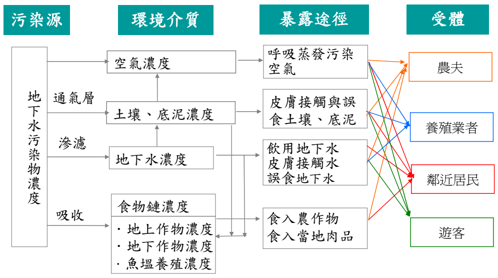
Future development

Revising/improving the guideline

- Based on the domestic conditions and cases
- Inclusion of food chain assessment
- Connection with the land use
- Total Petroleum Hydrocarbon (TPH) assessment





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Future development

Policy orientated

- Implementation of assessment system around Article 24
- Contaminated land risk and life cycle assessment
- Land revitalization
- Integration of land management and spatial planning

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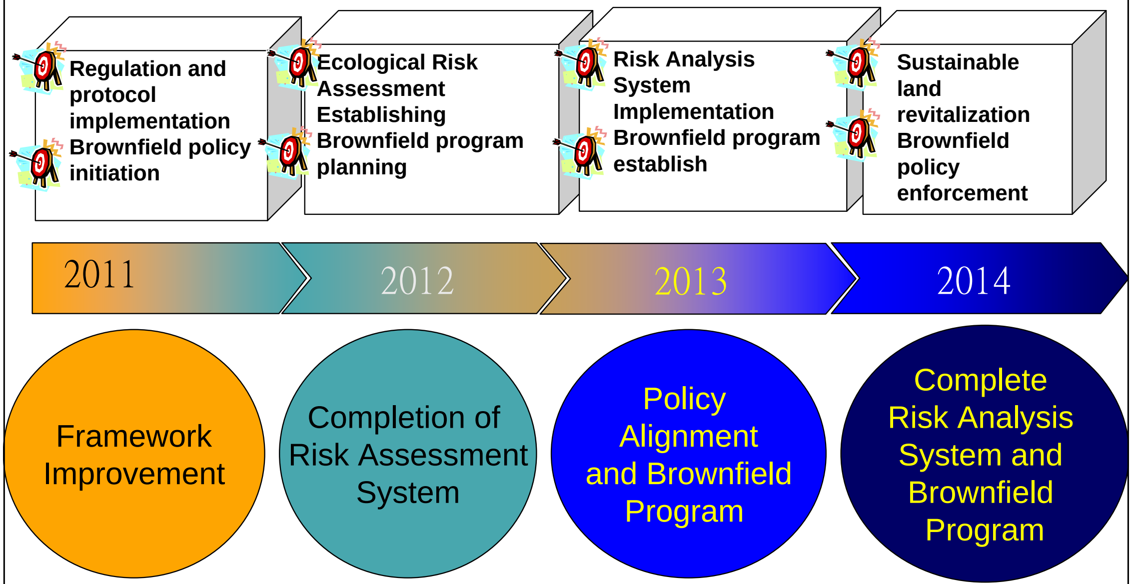
Future development

The Roadmap for Risk Assessment



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Future development

The Roadmap for Risk Assessment

- Implementing risk mapping and related information system
- Long term HHRA related research
  - Localization of parameters for the assessment
    - Exposure
    - Geological
  - Protocol improvement
- Interagency collaboration

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Future Development

- As a tool for land revitalization

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Thank you for your attention

Chih Huang
E-mail: chih@sinotech.org.tw
TEL: 886-2-27918858 ext 20
FAX: 886-2-27941354

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Risk Alleviation Methods to Heavy Metal Contamination in Soils and Crops: Research Development in Japan

Tomoyuki Makino

National Institute for Agro-Environmental Sciences
Kannondai 3-1-3, Tsukuba, Japan
Email: **t_makino@affrc.go.jp**

1. Introduction

Fast industrialization in the 1960s brought about serious soil pollution by heavy metals such as cadmium (Cd) in Japan. The Agricultural Land Soil Pollution Prevention Law was enacted in 1970 to cope with the heavy metal pollution. Cd, in particular, has been recognized as one of the most detrimental elements in Japan because of the so-called itai-itai disease caused by Cd uptake. Recently, Codex Alimentarius Commission proposed the maximum permissible concentration of Cd in polished rice and other relevant crops. Japanese government has just revised the Agricultural Land Soil Pollution Prevention Law in which the standard value is tightened from 1.0 to 0.4 mg Cd kg-1 on 16 Jun 2010. Therefore, it is a matter of urgency for the Japanese government to evaluate the Cd uptake risk for Japanese nationals and to minimize the Cd risk in terms of decreasing soil Cd contamination for food safety, hence human health (Makino, 2010).

This paper is to overview the soil contamination of heavy metals in Japan, in general, and Cd contamination, in particular. Appropriate technologies to minimize soil Cd contamination are to discuss and propose on; (1) water management to reduce bioavailability of soil Cd to rice plants, (2) addressing of, and/or replacement of contaminated soil with non-polluted soil, (3) phytoremediation of the polluted soil by rice and promising other crops, and (4) chemical remediation of Cd-contaminated soil by soil-washing with chemicals such as iron salts.

2. Conventional cultural practices to alleviate rice Cd contamination

1) Water management on paddy fields

Water management is a popular and cost-effective cultural practice for alleviating rice Cd contamination. When paddy field is flooded, the paddy soil is rapidly reduced, and consequently, its redox potential (Eh) is shifted toward a reduced state (a sharp decrease in Eh), where sulfate ion is able to be reduced to sulfide ion. The sulfide ion thus produced reacts with Cd to precipitate out of soil solution as cadmium sulfide. The precipitation of cadmium sulfide, in turn, lowers the Cd concentration in the soil solution, resulting in lowering the amount of the Cd bioavailable to rice plants. Flooding from tilling to head formation in rice growth stage would be the most effective period to decrease the Cd content in rice grains. It is highly recommendable to keep flooding the paddy fields as late as possible toward the harvest time, however, the later the flooding keeps, the more difficult machine operation for harvest becomes, so that we have to find the better meeting point between lowering bioavailable Cd and difficulty in machine operation.

2) Soil dressing

There are several methods to amend the polluted soils by soil dressing (Yamada, 2007): (1) Placing unpolluted soil on the top of polluted soil, (2) Removing the polluted soil and refilling it with unpolluted soil, and (3) Turning the soil layers upside down (exchanging the polluted topsoil with unpolluted subsoil). According to several follow-up surveys, the soil dressing is a very effective and reliable practice to decrease the Cd content in rice grains, when the unpolluted soil layer newly dressed is secured for 20–30 cm thick. However, this practice is costly and becoming increasing difficult for implementation as scarcity of suitable unpolluted soils.

3) Phytoremediation

Phytoremediation has drawn attention as a cost-effective and environmentally friendly technology to remove toxic materials from soils. Forms of phytoremediation include phytoextraction, phytovolatilization, phytostabilization, and rhizofiltration. Phytoextraction is the most popular technology and the most intensively examined. The capacity of a variety of plant species to extract Cd from polluted soils has been studied: tall goldenrod (*Solidago altissima* L.), Indian mustard (*Brassica juncea*), kenaf

(*Hibiscus cannabinus*), okra (*Abelmoschus esculentus*), sorghum (*Sorghum bicolor*), hakusanhatazao (*Arabidopsis halleri* ssp. gemmifera), members of the Asteraceae, sugar beet (*Beta vulgaris* L.), *Sedum plumbizincicola* and rice (*Oryza sativa* L.). Especially, some Japonica-Indica hybrid, and Indica rice variety are considered to be promising species for Cd phytoextraction from polluted paddy soils (Murakami et al., 2008). Although there are a couple of promising upland and/or perennial plant species with a high capacity of Cd extraction, it is difficult to vigorously grow these species in paddy soils, and it also takes a long time to return the once converted soil suitable for the upland species to the original paddy condition. On the other hand, any rice varieties, regardless of Indica, Japonica or their hybrid, are very easily adapted to paddy soils, and almost all the relevant cultural practices for rice cultivation are familiarized with rice growers.

4) Soil washing

Soil is conventionally washed off-site using specialized apparatus, in which extracting reagents are used to remove the metals into an aqueous solution. However, on-site soil washing technology should be suitable for paddy fields, where an impervious hardpan in the subsurface layer hinders the vertical movement of water, keeping the washed solution in the surface soil layer. A soil-washing method for practical use on cultivated land must meet the following criteria (Makino, et al. 2006, 2007, 2008, 2011): (1) It must be highly efficient and impose a low environmental load, (2) The washing and wastewater treatment systems must apply to paddy field conditions, (3) The soil fertility and crop growth must be not greatly affected by the washing treatment, and (4) The effect of washing should last for a reasonably long period.

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Risk Alleviation Methods for Heavy Metal Contamination in Soils and Crops: Research Development in Japan

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Tomoyuki Makino,

Topics of the presentation

① Overview of heavy metal contamination in Japanese agricultural soils.

② Promising technologies to alleviate Cd contamination of rice in Japan.

③ Practical washing method to remedy paddy soils contaminated with Cd.

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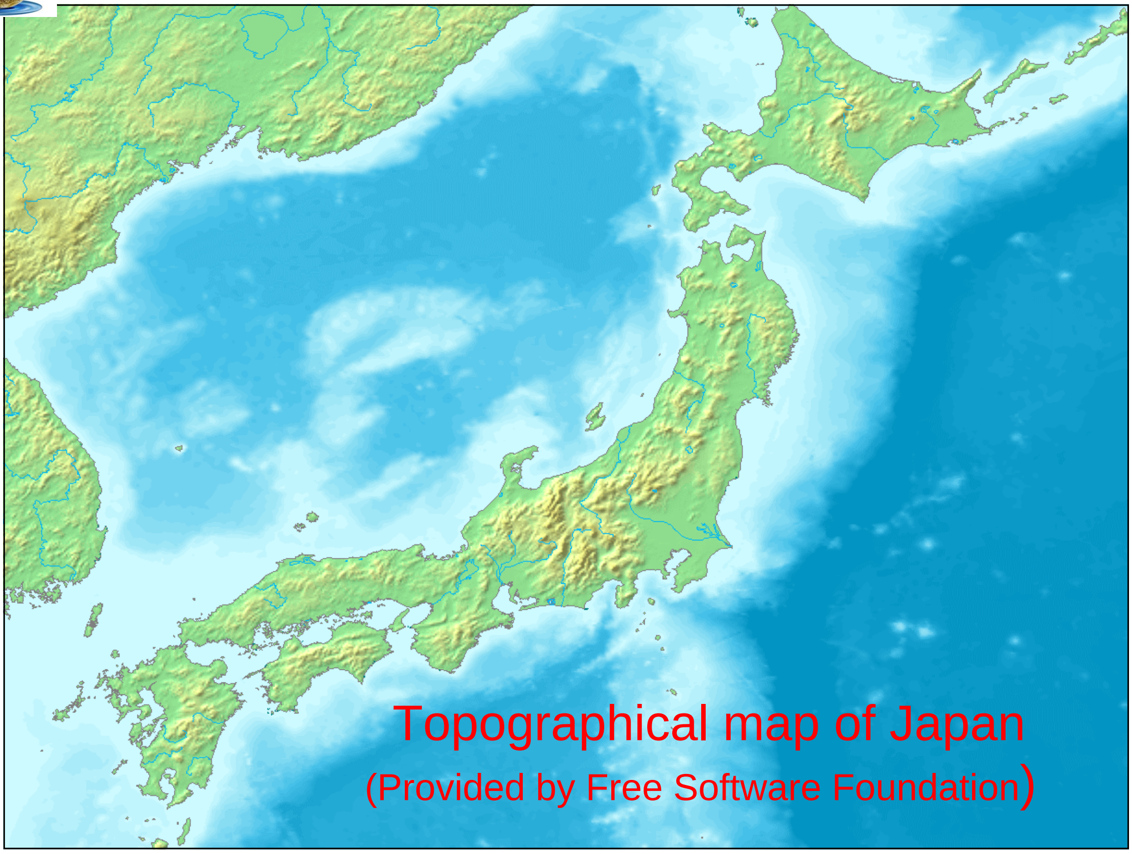
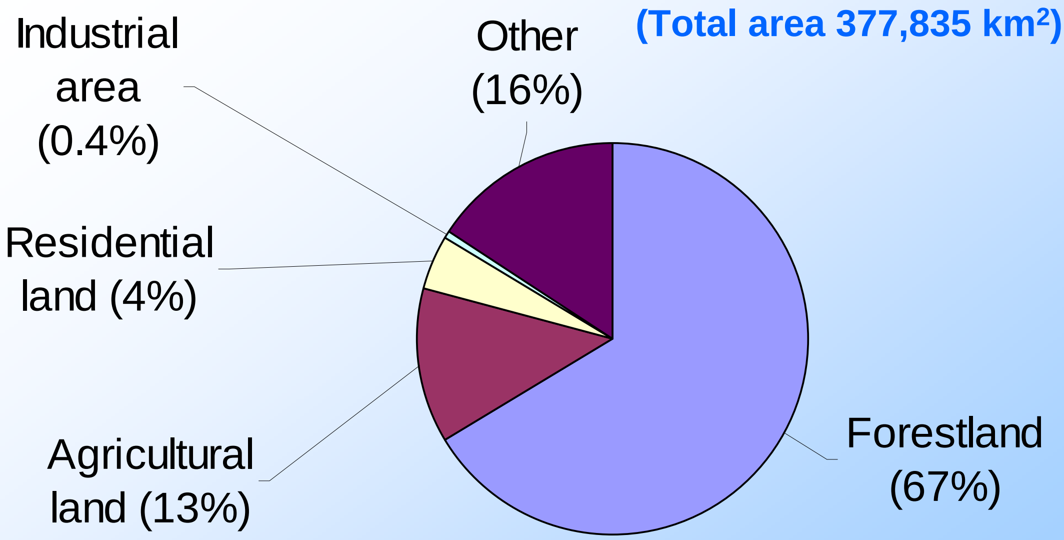




Japanese land-use map

(Ministry of Agricultural & Forestry of Japan (MAFF) white book, 2004)

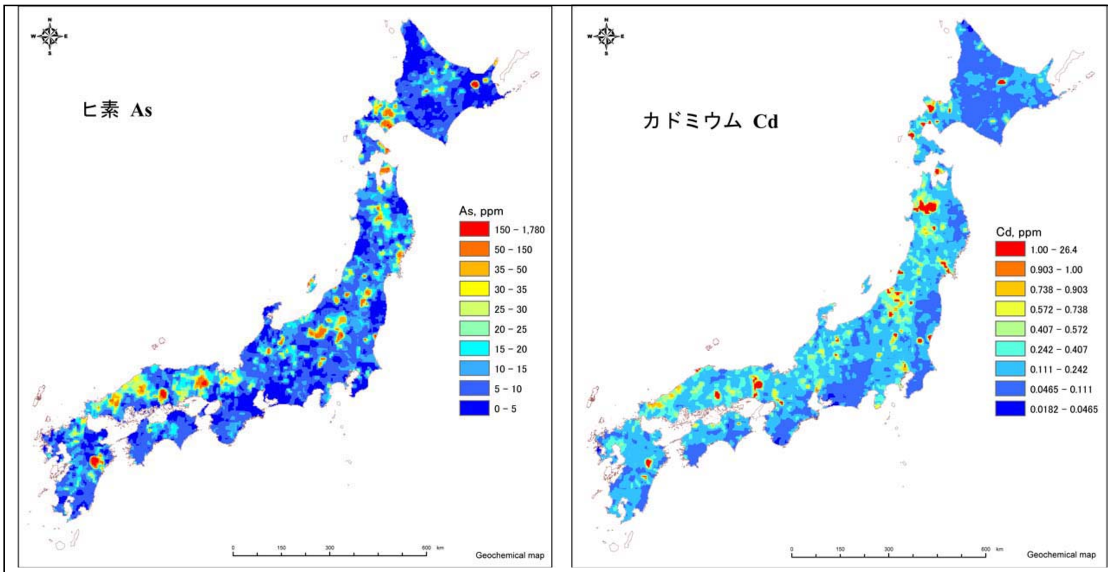
Japan is one of the volcanic countries. Volcanic ash soil has unique properties. →High C and non-crystalline minerals →High adsorption activity→ Heavy metal contents?

Natural abundance of heavy metals in Japanese soil and world soil (Average: mg kg^{-1}).

Substance	Surface soil		Paddy soils[b]	Brown rice[b]
	Japan[a]	World[c]		
Cr	58	63.7	64	—
Co	18	9.62	9	—
Ni	26	22.92	39	0.19
Cu	48	21.61	32	2.9
Zn	89	65.84	99	19
As	11[b]	8.93	9	0.16
Mo	1.3	2.10	—	—
Cd	0.3	0.48	0.45	0.07[d]
Hg	0.3[b]	0.13	0.32	0.013
Pb	24	29.85	29	0.19

a) Calculated from Yamasaki (2001), detailed data kindly provided.
b) Iimura (1981)
c) Calculated from Kabata-Pendias (2001)
d) MAFF (2002)

Japan ≈ World



Geochemical map of Japan for As & Cd (provided by geological survey of Japan).

Some areas are highly polluted with heavy metals in Japan. →need to regulation act.

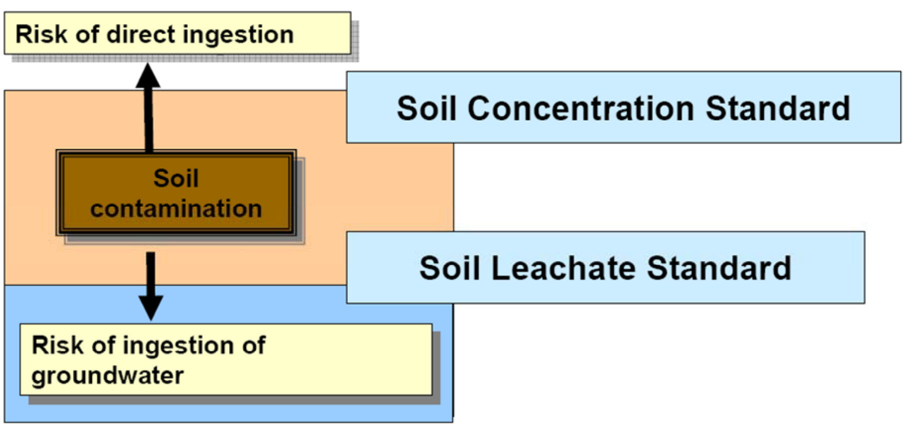
There are two main acts in Japan. Target substances and standards for heavy metal pollution of soils in the acts

Substance	Soil Contamination Countermeasures Law[1]		Agricultural Land Soil Pollution Prevention Law
	Soil concentration standard [2] (mg kg^{-1})	Soil Leachate Standard [3, 4] (mg L^{-1})	Concentration standard[4] (mg kg^{-1})
Cd	≤ 150	≤0.01	<1 in brown rice
As	≤ 150	≤0.01	<15 in soil (paddy fields only) [5]
Cu	No designation	No designation	<125 in soil (paddy fields only) [6]
Cr (VI)	≤ 250	≤0.05	No designation
Pb	≤ 150	≤0.01	No designation
Hg	≤ 15	≤0.0005	No designation
alkyl Hg	No designation	Not detectable	No designation
Se	≤ 150	≤0.01	No designation

1) The law also regulates fluorine, boron and hazardous organic substances.
2) Extracted with 1M HCl, soil/solution (w/v) % =3
3) Extracted with water, soil/water (w/v) = 0.1
4) Analysis methods and Standard values are identical with those in Environmental Quality Standard (MOE, 1991).
5) Extracted with 1M HCl, soil/solution (w/v) = 0.2
6) Extracted with 0.1M HCl, soil/solution (w/v) = 0.2

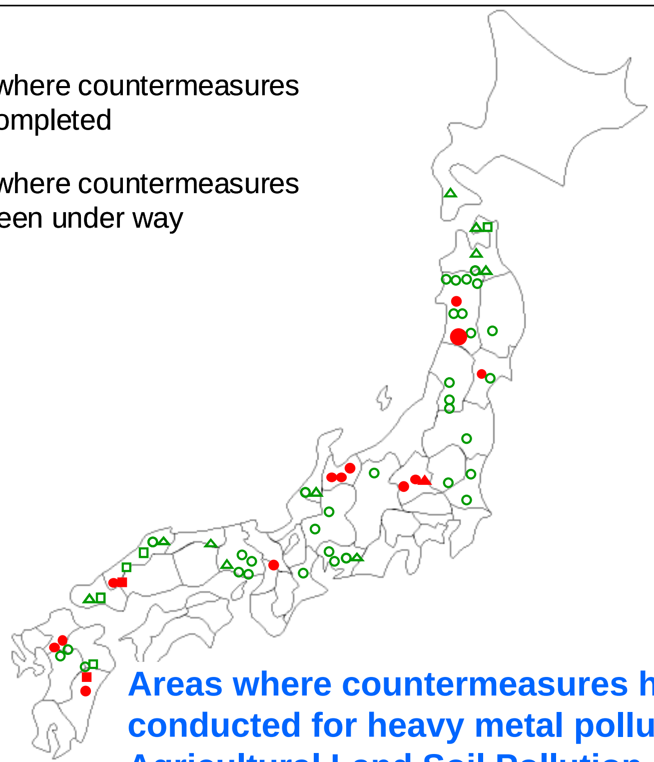
The 'Agricultural Land Act' designated areas where produced rice containing more than 1ppm Cd.
→Changed to 0.4ppm since June 16, 2010

Concept of designation standard by the Soil Contamination Countermeasures Act



○ −Cd, □ −As, △ −Cu: Areas where countermeasures were completed

● −Cd, ■ −As, ▲ −Cu: Areas where countermeasures have been under way



Areas where countermeasures has been conducted for heavy metal pollution under the Agricultural Land Soil Pollution Prevention Law

As of 2010, more than 88% of the land has been remedied.

Soil dressing; Conventional Countermeasure

Soil Dressing

contaminated Soil → contaminated Soil → Uncontaminated Soil (20～40cm) / contaminated Soil

Problems

1) **Insufficient of material (Soil from mountain)**
2) **Decline of soil fertility**
3) **High cost**

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Need new methods to minimize Cd contamination in crops.

Topics of the presentation

① Overview of heavy metal contamination in Japan.

② Promising technologies to alleviate Cd contamination of rice.

③ Practical washing method to apply paddy soils contaminated with Cd.

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Promising technologies to minimize Cd contamination in crops.

Cultural practices to alleviate Cd concentration in Crops

Water management to reduce Cd bioavailability to rice plant

Remediation of Cd-contaminated soil

Phytoremediation

Soil washing (Flushing)

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Water management

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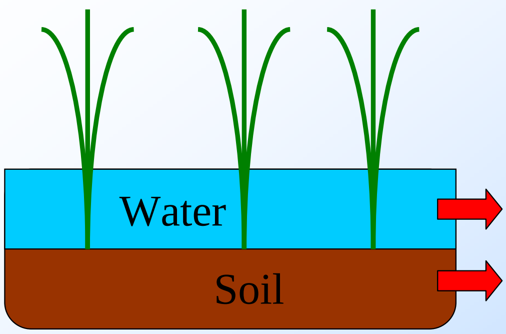

Suppression of O_2 supply.

Reduction.

Reduction of paddy soil by covering with water.

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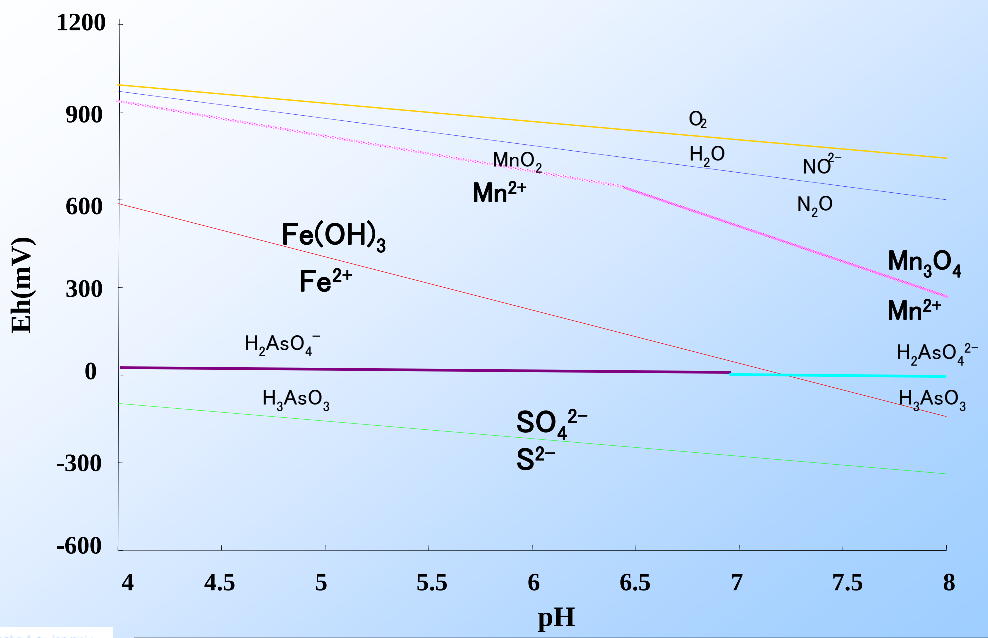
Eh-pH diagram calculated by Gibbs free energy(278k)



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Sulfide ion generates under reduced condition, which forms hardly dissolved CdS.

Water management

Intermitted irrigation (Normal)

water level	5 cm above ground level	zero		5 cm			zero
water control	flooded	MD	II	IF	II		drained
soil redox state	reduced	o	r o r o r o	reduced	o r o r o r		oxidized

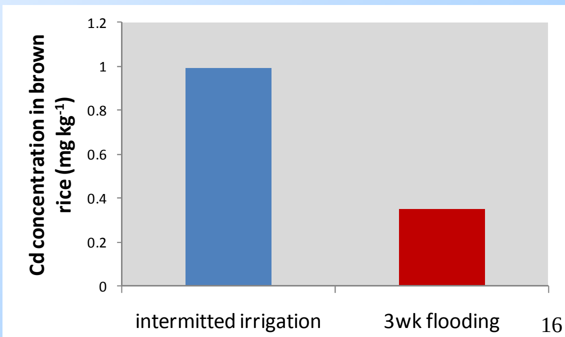
MD, mid-season drainage; II, intermittent irrigation; IF, irrigation at flowering stage

flooding for 3wk before and after heading (for suppressing Cd uptake)

water level	5 cm above ground level	zero	5 cm above ground level	zero
water control	flooded	MD	flooded	drained
soil redox state	reduced (r)	o	reduced (r)	oxidized

Cd speciation in
Flooded (reduced) soil:
$Cd^{2+} + S^{2-} = CdS\downarrow$
(hardly soluble)

Drained (oxidized) soil:
$CdS\downarrow + 2O_2 = Cd^{2+}$ (soluble) $+ SO_4^{2-}$



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Water management is cost-effective and useful method to decrease Cd concentration in rice grain.

Phytoremediation

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Plants for phytoextraction to restore Cd-contaminated soil in Japan.

Plant	Author
Tall goldenrod (S. altissima L)	Tatekawa et al., 1975
Indian mustard (Brassica juncea)	Yanai et. al.,2004
Sorghum (Sorghum bicolor)	Kato et al, 2004
Hakusanhatazao (Arabidopsis halleri ssp. Gemmifera)	Nagashima et al., 2005
Kenaf (Hibiscus cannabinus.)	Kurihara et al., 2005
Okra (Abelmoschus esculentu.)	Kurihara et al., 2005
Sugar beet (Beta vulgaris L.)	Ishikawa et al., 2006
Asteraceae	Watanabe and Sasaya, 2007
rice (Oryza sativa L.)	Murakami et al., 2007

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Rice is suitable for phytoremediation on paddy fields, as cultivation method has been well known.

Rice cultivars classified according grain Cd concentration

Rice cultivars

Lowest Cd	Low Cd	High Cd	Highest Cd
•LAC23 •Hu-Lo-Tao	•Nipponbare •Koshihikari •Sasanishiki, etc.	•IR-8 •Milyang23 •Habataki, etc.	•Jarjan •Anjana Dhan •Cho-ko-koku

Highest Cd: Phytoremediation.

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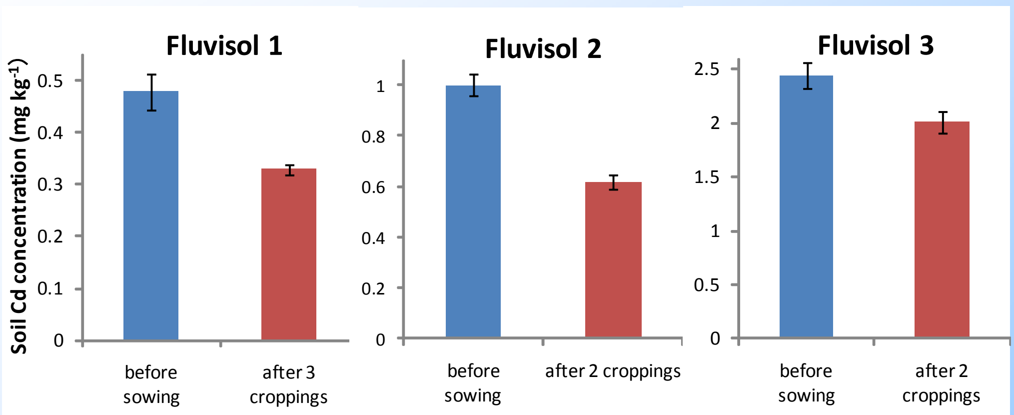
We used Cho-ko-koku variety for phytoremediation on paddy fields.

Changes of soil-Cd after phytoremediation



All shoots were carried out from the field after every harvest

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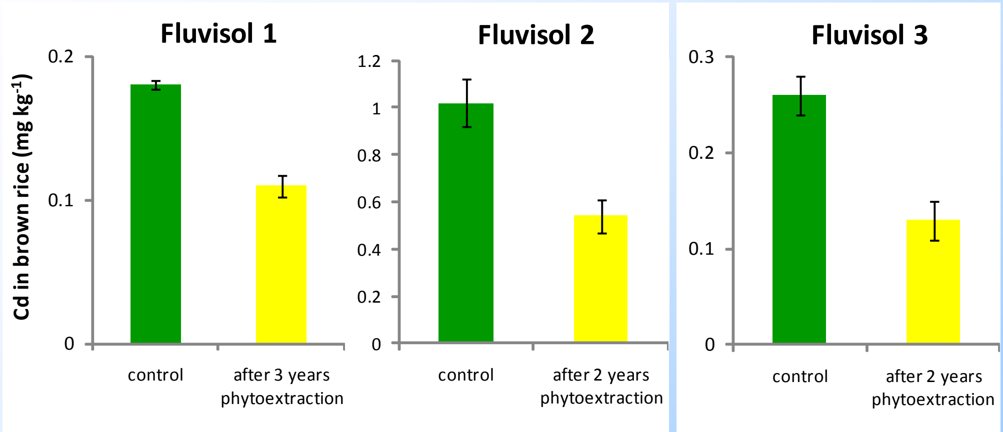
After 2 or 3 years phytoextraction, 20~40% of soil Cd were decreased.

Changes of rice Cd in grain after phytoremediation



40～50％ of Cd in food rice were decreased.

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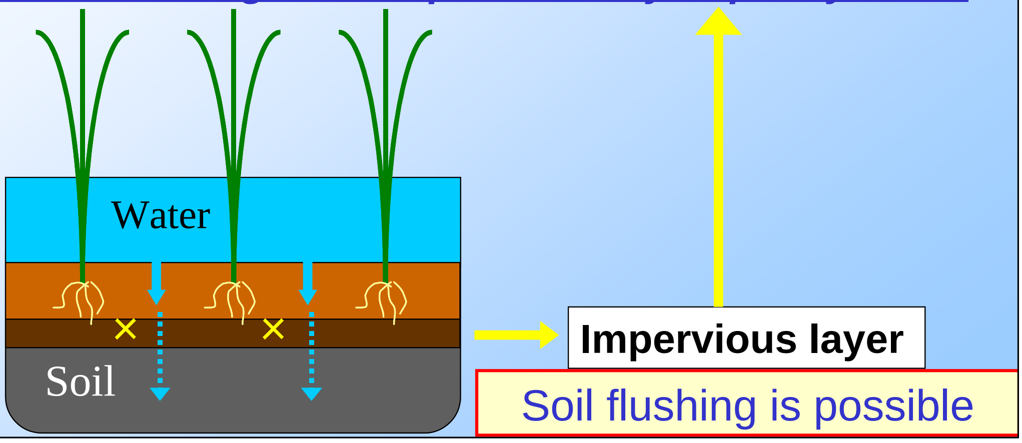
Soil washing (Flushing)

soil washing method

(1) Short period of time required

(2) High removal efficiency

(3) Take advantage of low permeability of paddy fields

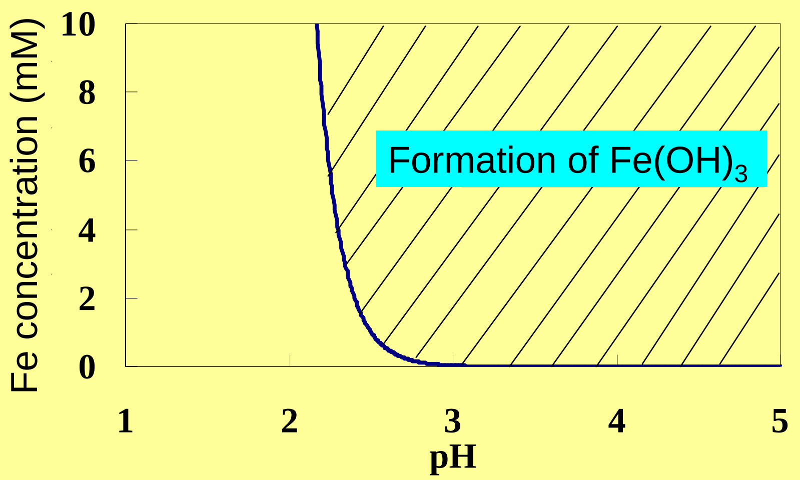


Application of Soil washing (Flushing) on Agricultural field

1. **Identification of wash chemicals with minimal environmental impact on the field and its surrounding environment, but with high Cd-removal efficiency.**

2. **Preservation of soil fertility and healthy growth of crops after the wash treatment.**

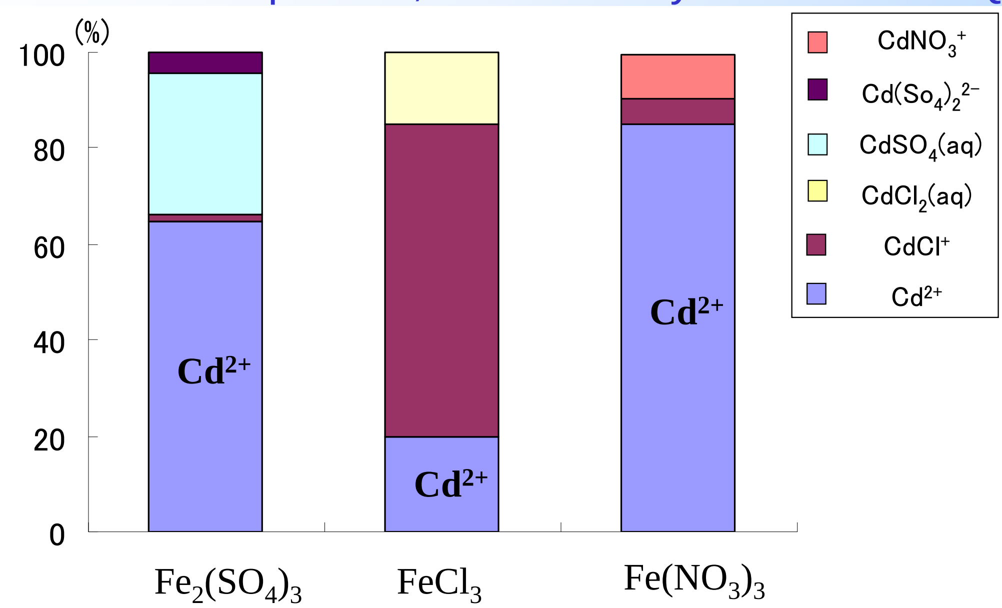
Soil washing chemical: $FeCl_3$
Cd extraction mechanism of $FeCl_3$



($FeCl_3 \rightarrow Fe^{3+} + 3Cl^-$, $Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$)

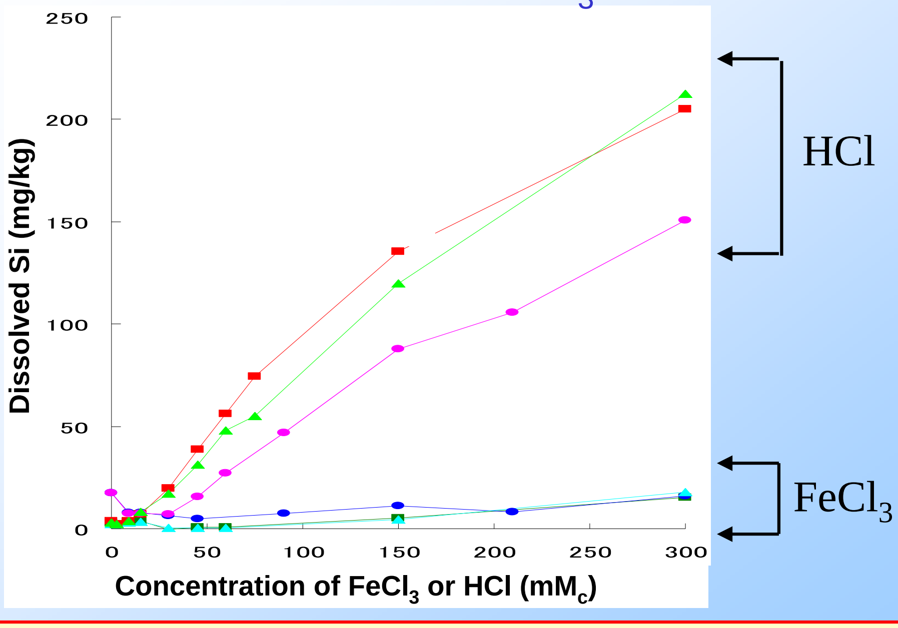
Primary extraction mechanisms is proton release along with $Fe(OH)_3$ formation (hydrolysis of $FeCl_3$)

Relative abundance of various Cd species in the extracts of the Nagano soil in the presence of the three iron compounds, calculated by Visual MINTEQ.



→Promotion of Cd extraction with Cd-Cl complexation

Soil-Si dissolution by washing treatment with HCl or $FeCl_3$



→The effect of $FeCl_3$ on clay minerals is less than that of HCl, even if excess amount is applied to soils.

(5/19)

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Process of soil flushing

①Application of washing chemicals

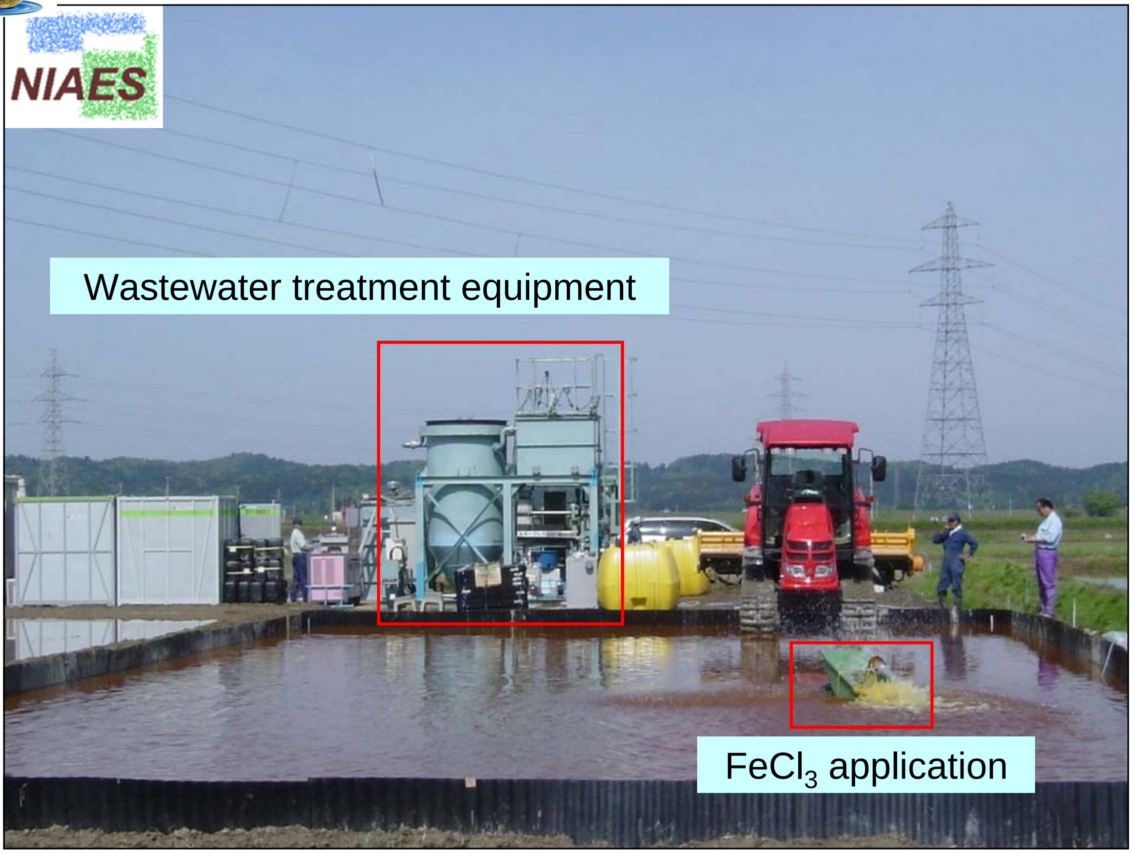
②Mixing (Extraction of Cd)

③Sedimentation and drainage

④Treatment of wastewater

⑤Discharge of treated wastewater

⑥ Water washing



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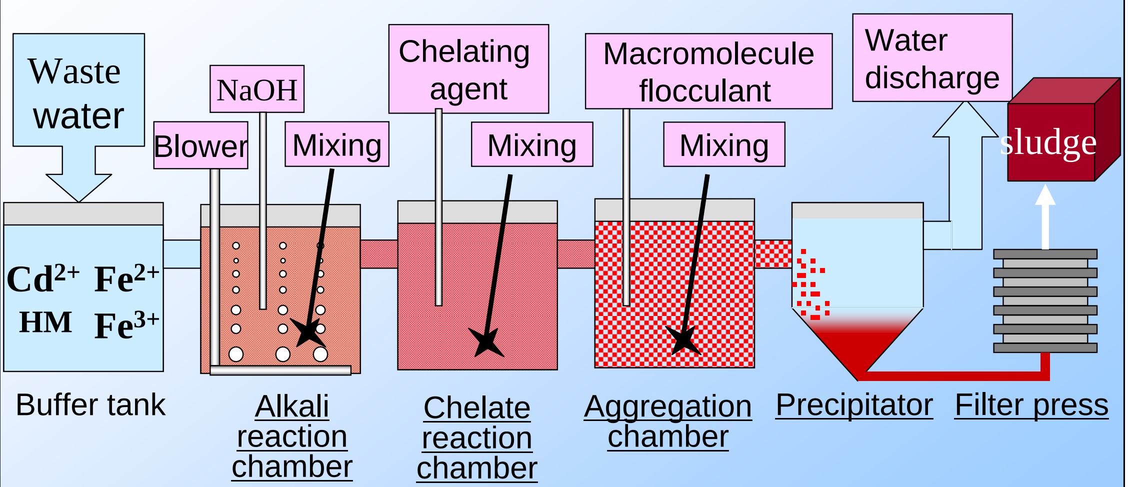
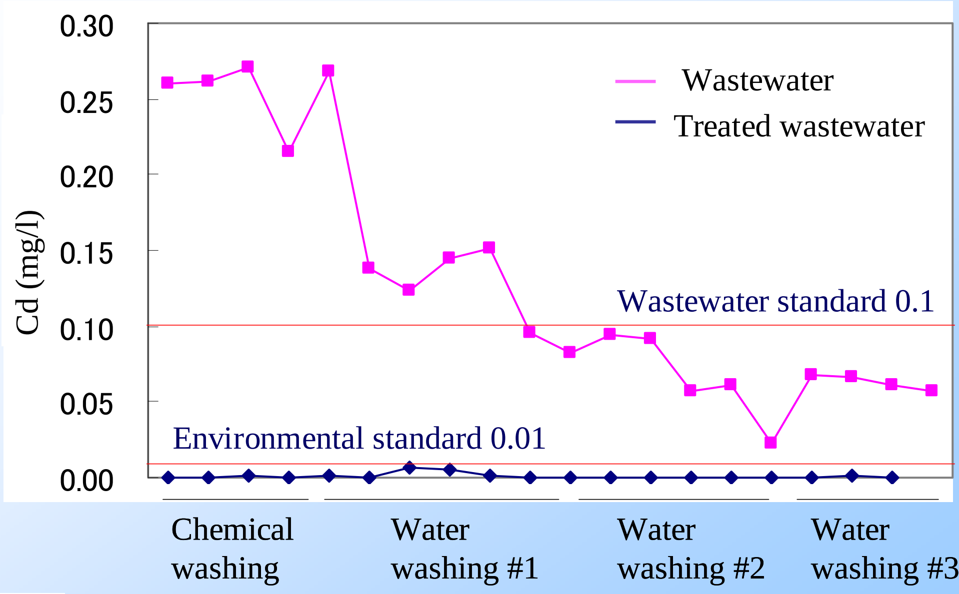
Wastewater treatment system with flocculation method



Profile of Cd concentration in the wastewater and treated wastewater generated at soil flushing.



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→Cd was effectively removed from wastewater in situ.

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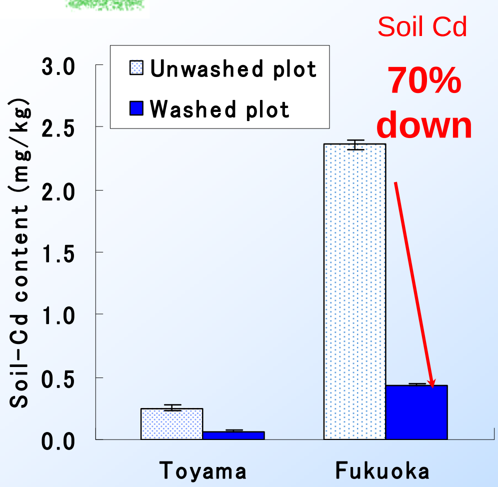
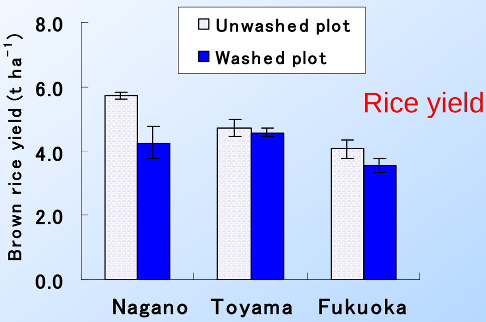
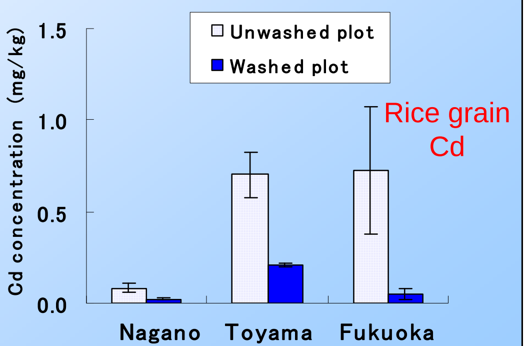


Changes of soil Cd content with the soil washing.





Changes of rice-Cd and -yield with the soil washing.

Soil flushing is effective to remove Cd from soils and rice.

Summary

(1)Natural abundance of heavy metals in Japan is almost same that in the world.

(2) Regulation of heavy metals in soil and present condition of the countermeasure were introduced.

(3) Soil dressing and water management are conventional countermeasure for Cd contamination .

(4) Phytoremediation and soil washing methods are new promising technologies to remedy Cd contaminated soil.

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Policy and Legal Framework on Soil Contamination Management

2011. 6.

CONTENTS

I. Soil Environment Policy in Korea

1-1. History of Soil Environment Policy

Early Phase(before 1980)

- Farmland-centered soil management policy for increase of production
- Soil contamination occurred such as excessive uses of soil and chemicals
- Little understanding of soils, absence of soil policy
  - Establish the Environmental Pollution Preservation Act ('63.11.5) and Decree ('69.11)

Growth Phase(1980~1994)

- Development of heavy chemical industry → Serious soil contamination
  - Set up Ministry of Environment ('80.1.5), a unit to take charge in soils
- Run soil measuring networks, conduct soil contamination survey throughout the country('87)
- Establish Framework Act on Environmental Policy
- Divide the law into air, water, waste, and/or natural environment
- MOE was raised to higher status('90)
  - Soil management Dept. became soil conservation Dept.

1-1. History of Soil Environment Policy

Development Phase(after 1995)

- Try to conserve soil environment by prevention and remediation
- Establish Soil Environment Conservation Act('95.1), Decree and Regulations('96.1)
- Expansion and tightened responsibility of person causing pollution, introduction of Assessment of Soil Environment ('03.1)
- Introduce system of advanced countries such as risk assessment, registration of soil remediation work, verification of soil remediation('04.12)

1-2. Base for Soil Environment Conservation

Establish Single Law

- Until 1970s, soil was treated and managed as parts of water, waste and/or natural environment
- After 1970s, soil contamination became serious social problem due to recklessly discharge of contaminants and absence of systematic control
- Need for comprehensive and systematic policy for soil environment conservation is raised
- Establish Soil Environment Conservation Act ('95)
  - It is the second single law in the world after Netherland

1-3. Structure of Soil Environment Conservation Act

General provisions
- Purpose
- Definitions
- Formulation of basic plan
- Soil contamination level
- Measuring network
- Expropriation of land
- Entry to land
- Compensation for loss
- Assessment of soil environment
- Strict liability

Regulation on soil contamination
- Control of specific soil contamination
- Report on facilities
- Soil contamination survey
- Order given to installer
- Orders to take preventive measures
- Remediation of contaminated soils
- Risk assessment
- Verification of remediation

Designation and maintenance of region
- Response level
- Designation of area
- Formulation and execution of plan
- Project to improve contaminated soil
- Limitation on use of land
- Limitation on activities
- Cancellation of designation

Soil-related specialized agency
- Designation of special agency
- Disqualifications
- Prohibition on concurrently running other businesses
- Revocation of designation

Soil remediation
- Registration of soil remediation business
- Grounds of disqualification
- Matters to be observed
- Revocation of registration
- Training of technical manpower

Supplementary provisions
- Execution by proxy
- Assistance from relevant organizations
- State subsidy
- Report and examination
- Report on current state
- Standards for administrative disposition
- Hearing
- Delegation of powers

1-4. Standard of Soil Environment Management

Set soil contamination standard

- 21 items (Cd, Cu, As, Hg, petroleum, organic solvents) were chosen as soil contaminants
  - Divide into two standards, worrisome level and response level considering effects on human health or properties or rearing of animals and plant
  - Change from elution method into content method for management based on risks

Remediation Standards for contaminated soils

- Remediation standards are established as worrisome level.
- Remediation work are decided to be conducted by soil remediation business operator with biological, physical, chemical and thermal processes regulated by Soil Environment Conservation Act.

1-4. Standard of Soil Environment Management

Worrisome level of soil contamination

<valid until 2009.12.31>

Material	Area A	Area B
Cd	1.5	12
Cu	50	200
As	6	20
Hg	4	16
Pb	100	400
Cr^{6+}	4	12
Zn	300	800
Ni	40	160
F	400	800
Organic Phosphorus	10	30
PCB	-	12
CN^-	2	120
Phenol	4	20
Petroleum		
-BTEX	-	80
-TPH	500	2,000
TCE	8	40
PCE	4	24

Area A : farm, rice paddy, orchard, woodland, school, river, park, gym, amusement park, religious site, historic site.

Area B : factory, road, railroad, etc.

<valid from 2010.1.1>

Material	Area 1	Area 2	Area 3
Cd	4	10	60
Cu	150	500	2,000
As	25	50	200
Hg	4	10	20
Pb	200	400	700
Cr^{6+}	5	15	40
Zn	300	600	2,000
Ni	100	200	500
F	400	400	800
Organic Phosphorus	10	10	30
PCB	1	4	12
CN^-	2	2	120
Phenol	4	4	20
Benzene	1	1	3
Toluene	20	20	60
Ethylbenzene	50	50	340
Xylene	15	15	45
TPH	500	800	2,000
TCE	8	8	40
PCE	4	4	25
Benzo(a)pyrene	0.7	2	7

Area 1 : farm, rice paddy, orchard, spring, university, fishery, park, historic site, cemetery
Area 2 : woodland, ·salt pond, warehouse, river, gym, amusement park, etc.

Area 3 : factory, parking lot, gas station, road, railroad, embankment, military facility

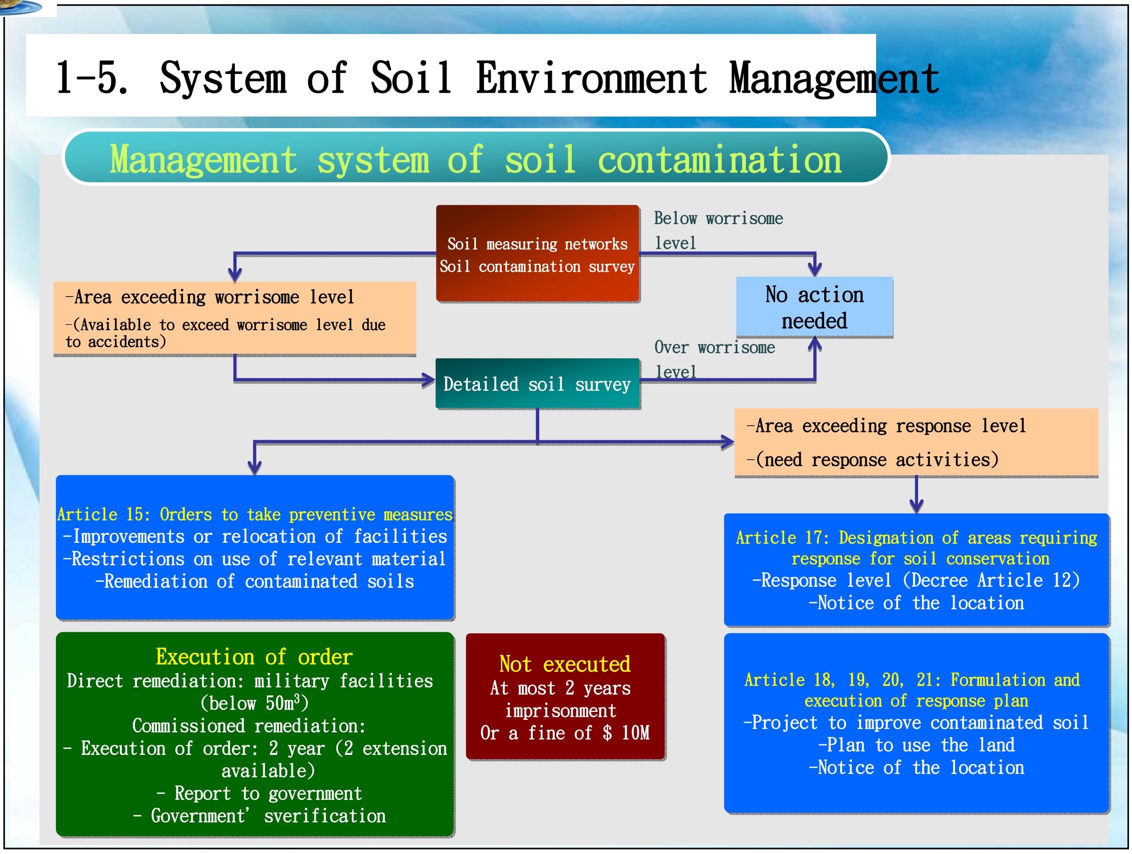
1-5. System of Soil Environment Management

Survey and remediation

Survey →

- **Nation**: Soil measuring networks(Regional MOE); Soil contamination survey (city, provinces)
- **Private**: Examination of soil contamination; Soil environment assessment

Remediation → **Polluter pays principle**: Polluter, owner, occupant, operator


1-5. System of Soil Environment Management
Management system of soil contamination
Soil measuring networks
Soil contamination survey
Below worrisome level
No action needed
-Area exceeding worrisome level
-(Available to exceed worrisome level due to accidents)
Detailed soil survey
Over worrisome level
-Area exceeding response level
-(need response activities)
Article 15: Orders to take preventive measures
-Improvements or relocation of facilities
-Restrictions on use of relevant material
-Remediation of contaminated soils
Article 17: Designation of areas requiring response for soil conservation
-Response level (Decree Article 12)
-Notice of the location
Execution of order
Direct remediation: military facilities (below 50m³)
Commissioned remediation:
- Execution of order: 2 year (2 extension available)
- Report to government
- Government' sverification
Not executed
At most 2 years imprisonment
Or a fine of $ 10M
Article 18, 19, 20, 21: Formulation and execution of response plan
-Project to improve contaminated soil
-Plan to use the land
-Notice of the location


Ⅱ. Introduction for the Risk Assessment

2-1. Risk Assessment Policy

Prescription of Risk Assessment (Article15-4)

- The Minister of Environment, the governor of a province, and Polluter can hire a risk assessment agency to measure the impact of soil contaminant to human and environment, considering the kind and degree of contaminants, surrounding environment, future usage of the property and other related concerns to decide the scope, time and the level of remediation.

Conditions Requiring Risk Assessment

- If a property belongs to the nation, and the Minister of Environment is responsible for remediation (nation is the polluter, and the issue is urgent)
- Polluter cannot be identified, or the polluter cannot take remediation action
- Pollution has been resulted from a natural cause
- Other cases requiring Risk Assessment

2-1. Risk Assessment Policy

Ways to prove nature-caused soil contamination

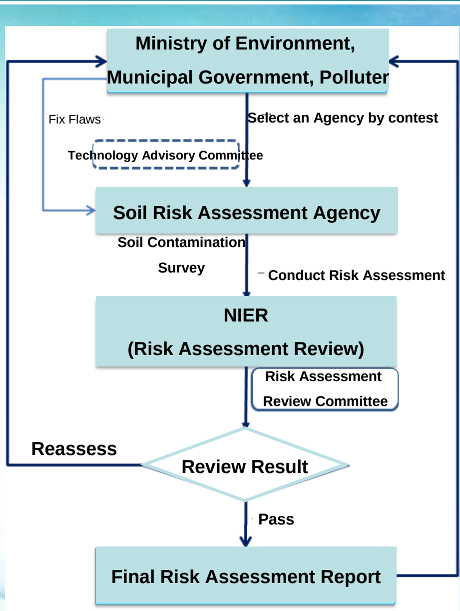
- If the degree of soil contamination in the subjected area is similar with the background level of the vicinity area
- If contamination has occurred by bedrock, according to the geophysical characteristics survey result
- If there is a scientific proof of natural sources of soil contamination

Qualifications of a Risk Assessment Agency

- A qualified agency should be able to take soil sample and analyze the degree of soil contamination, have specialists in soil risk assessment, and be certified by the Minister of Environment.

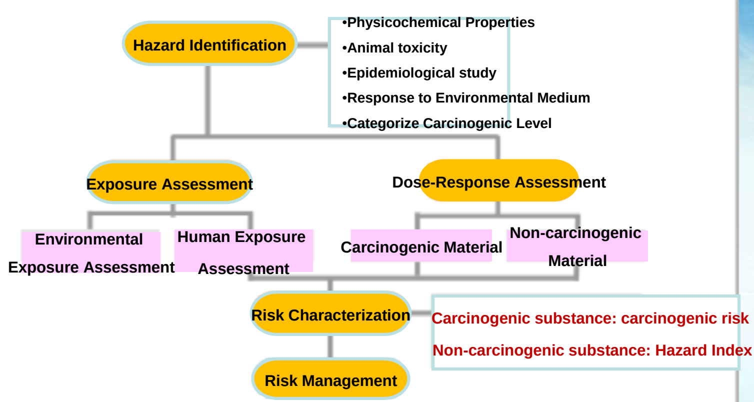
2-1. Risk Assessment Policy

Risk Assessment Process and Verification

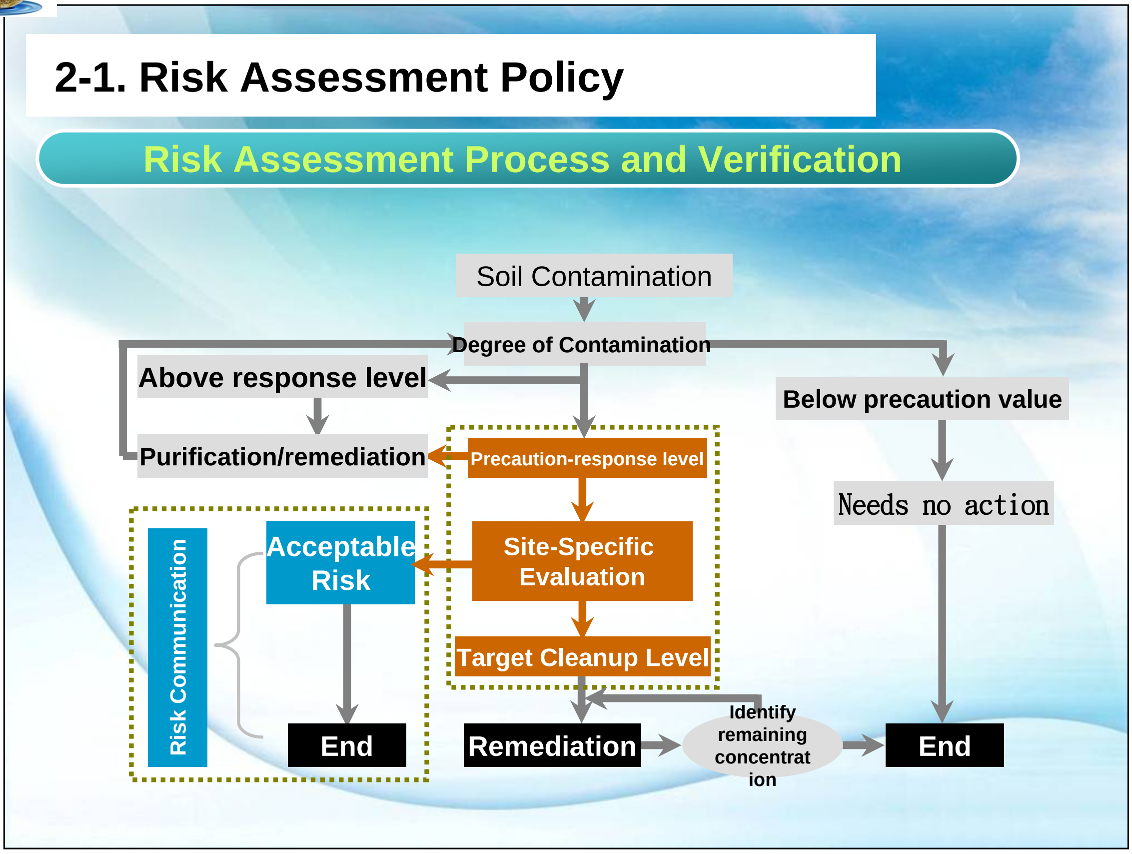


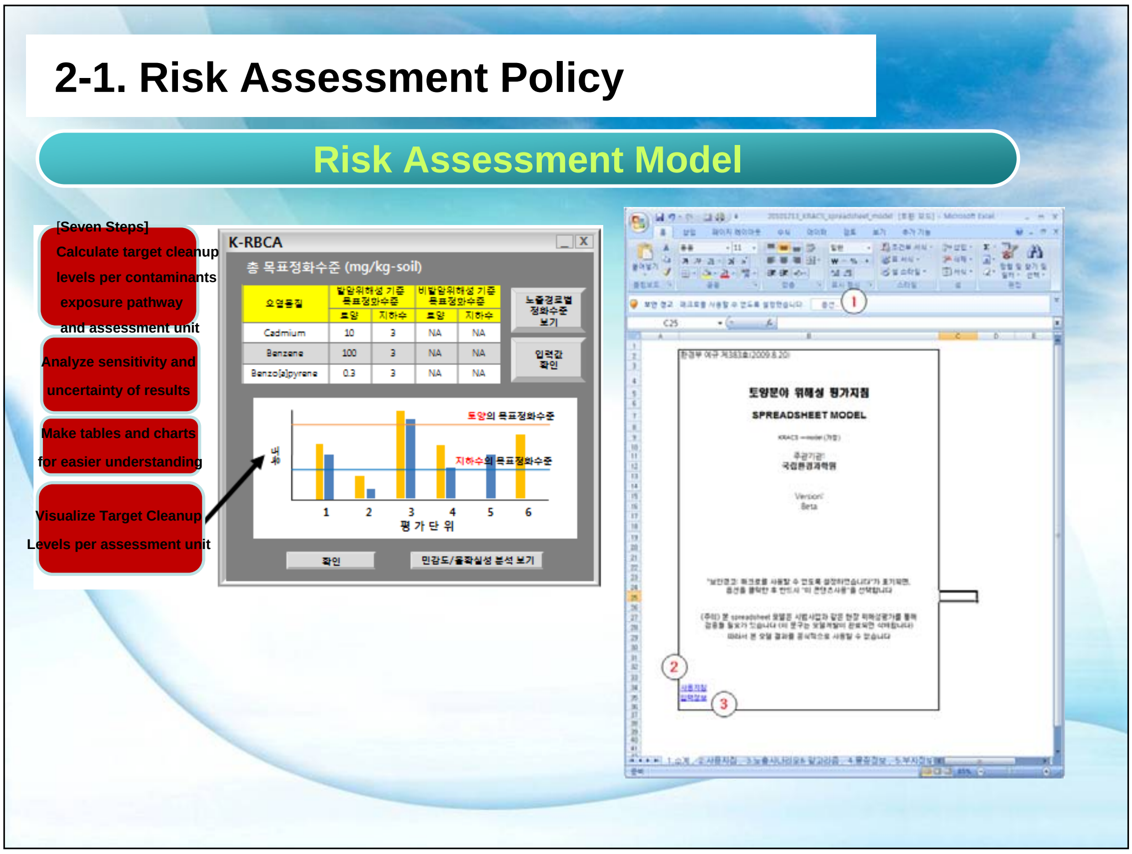
2-1. Risk Assessment Policy

Risk Assessment Process and Verification



[Figure 31] Risk Assessment Procedure

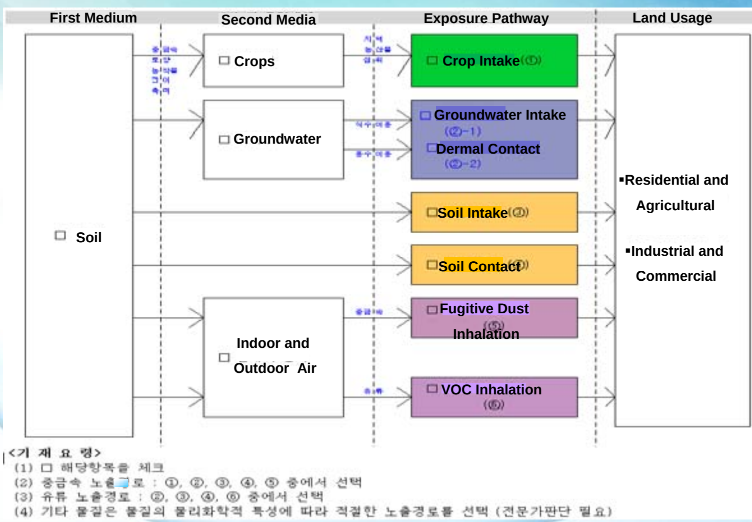

2-1. Risk Assessment Policy
Risk Assessment Process and Verification
Soil Contamination
Degree of Contamination
Above response level
Below precaution value
Purification/remediation
Precaution-response level
Needs no action
Risk Communication
Acceptable Risk
Site-Specific Evaluation
Target Cleanup Level
End
Remediation
Identify remaining concentrat ion
End


2-1. Risk Assessment Policy
Risk Assessment Model
[Seven Steps]
Calculate target cleanup levels per contaminants exposure pathway and assessment unit
Analyze sensitivity and uncertainty of results
Make tables and charts for easier understanding
Visualize Target Cleanup Levels per assessment unit
K-RBCA
총 목표정화수준 (mg/kg-soil)
오염물질
발암위해성 기준 목표정화수준
비발암위해성 기준 목표정화수준
토양
지하수
Cadmium 10 3 NA NA
Benzene 100 3 NA NA
Benzo[a]pyrene 0.3 3 NA NA
노출경로별 정화수준 보기
입력값 확인
토양의 목표정화수준
지하수의 목표정화수준
1 2 3 4 5 6
평 가 단 위
확인
민감도/불확실성 분석 보기
SPREADSHEET MODEL

2-1. Risk Assessment Policy

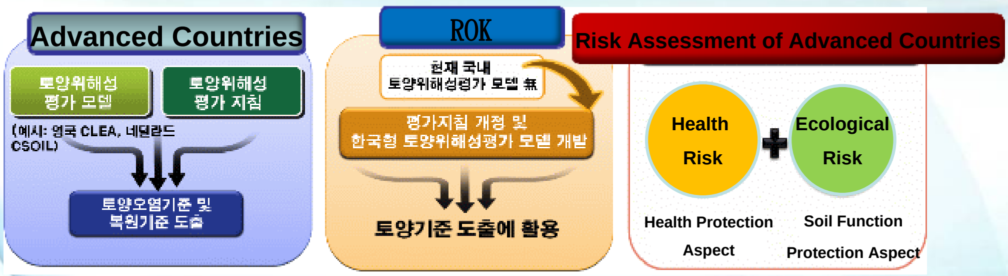
Direction of Risk Assessment

- Human Exposure Pathway Selection



2-1. Risk Assessment Policy

Direction of Risk Assessment

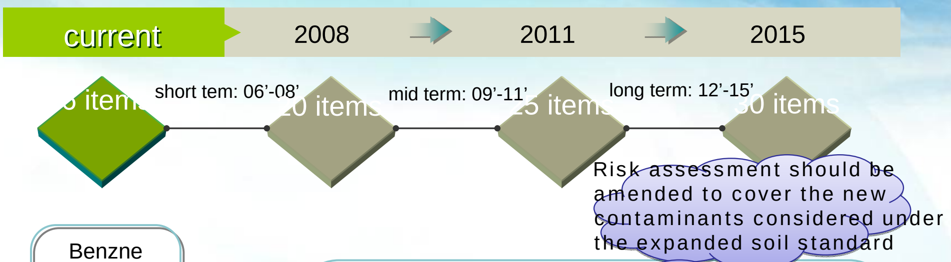


2-1. Risk Assessment Policy

Direction of Risk Assessment

Materials Subjected to Assessment

<Research for Establishing Basic Soil Conservation Plan>



Subject materials under the soil risk assessment guidance

Benzne
Tolune
Ethyl benzene
Xylene
Cd
Cu
As
Hg
Cr^{6+}
Zn
Ni

EXPANDED MATERIALS

1) Heavy metals: antimony, selenium, barium
2) Chlorinated Organic Compound: 1,2-dichloroethane, tetrachloromethane, dichloromethane
3) Aromatic Compound: benzo(*a*)pyrene, naphthalene, styrene
4) Agrichemicals and others: MTBE, dieldrin, boron, DDT

2-1. Risk Assessment Policy

Direction of Risk Assessment

2010	- Develop and reveal a Window-based Korean model of soil risk assessment - Assess the risk to human and research the exposure
2011	- Continue to expand the soil risk assessment model - Research the risk assessment of pollutant compounds
2012	- Continue to expand soil risk assessment model - Research ecological risk assessment and exposure - Research risk assessment to establish soil environment standard and remediation standard including new contaminants
2013 -	- Continue to expand soil risk assessment model - Research risk assessment for human and ecology - Research exposure assessment of soil contaminants from multiple media - Research property characteristics and risk assessment per each characteristics

Thank you !

Risk Assessment for Heavy Metals in the Abandoned Mine Areas

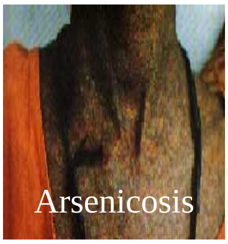
Jae E. Yang*, Kim Dongjin and Yi, Jinwon

Kangwon Nat'l University and Ministry of Environment, KOREA

2011-06-26 1

Heavy Metal Poisoning

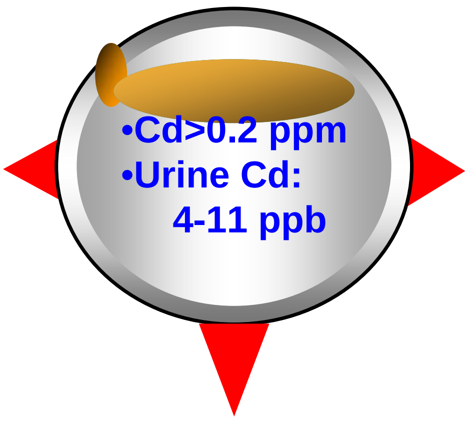
Cd	Hg	As	Pb	CH_3Hg



Crop Safety Issues :

Cd in Rice (2004) & Pb in Kimchi (2005)

Mining Impacts



Itai Itai Diseases????

Economical and Social Impacts

Safety Issues on Cd Contents in Rice

- After decades of researches to clarify potential Cd risk to humans from the land-applied residuals, it has become clear that only one population group has experienced Cd disease from food, the subsistence rice consumers who ate home-grown rice produced on the contaminated paddy soil (Basta et al., 2005)
- No direct evidence so far for the metal poisoning (e.g., Itai-Itai disease) from rice consumption in Korea
- What we need is the holistic management of paddy soils in order to avoid the contamination and poisoning from heavy metals

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Objectives

- Risk Assessment for Health Hazard in Metal Contaminated Mining Areas

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Sources of Heavy Metal Contamination in Paddy Soils

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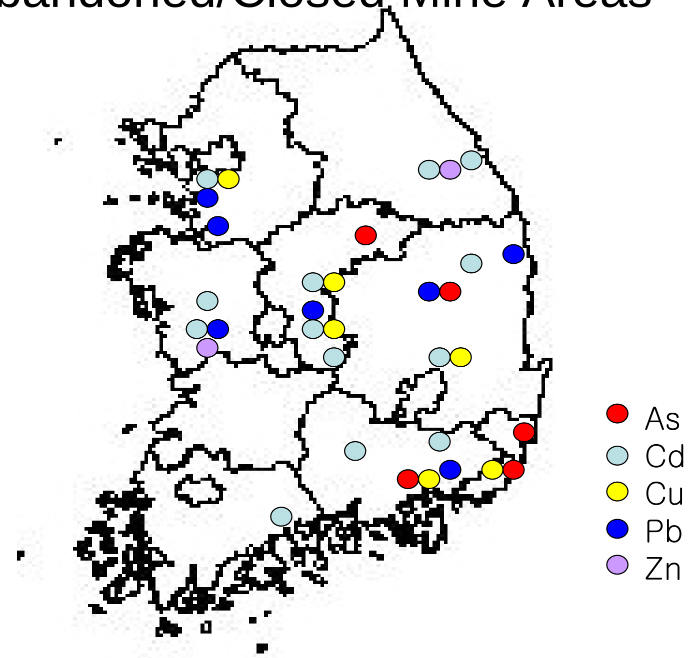
Yellowboy

8 2011-06-26

Aluminum Whitening

9 2011-06-26

Survey on Contaminated Paddy Fields and Rice In Abandoned/Closed Mine Areas



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Heavy Metal Contents in Paddy Soils

Soils	Samples	Cd	Cu	Pb	Zn
		-------mg/kg-------			
Paddy (Unpolluted)	407	0.13	4.15	4.67	3.95
	330	0.14	4.00	5.38	4.36
	Average	0.13	4.08	4.99	4.13
Paddy (Polluted, mining area)	28	7.35 0.30~16.83	35.83 0.39~138.3	98.86 2.19~522.5	118.77 9.42~511.0
Threshold of Danger Level		1.5	50	100	300
Corrective Action Level		4	125	300	700

Heavy Metal Contents in Crops in Mining Areas

Crops		Cd		Pb		As
		mg/kg	Codex	mg/kg	Codex	mg/kg
Rice (136)	Max	0.706	0.2	0.445	0.2	0.162
	Min	0.000		0.014		0.038
	Mean	0.039		0.120		0.090
Corn (95)	Max	0.150	0.1	0.714	-	0.144
	Min	0.000		0.082		0.000
	Mean	0.006		0.155		0.020
Potato (64)	Max	0.550	0.1	0.320	0.1	0.130
	Min	0.050		0.080		0.000
	Mean	0.187		0.173		0.026
Cabbage (145)	Max	1.702	0.2	4.132	0.3	1.516
	Min	0.055		0.079		0.022
	Mean	0.332		0.477		0.176

Crop Safety Criteria for Cd and Pb in Korea

Crops	Cd (mg/kg)	Pb (mg/kg)
Rice (peeled)	<0.2	<0.2
Corn	<0.1	<0.2
Soybean	<0.1	<0.2
Red bean	<0.1	<0.2
Potato	<0.1	<0.1
Sweet potato	<0.1	<0.1
Chinese cabbage	<0.2	<0.3
Radish	<0.1	<0.1
Green onion	<0.05	<0.1
Spinach	<0.2	<0.3

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Risk Assessment of Heavy Metals in the Abandoned Mine Areas

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Heavy Metal Concentrations in Tailings and Soils

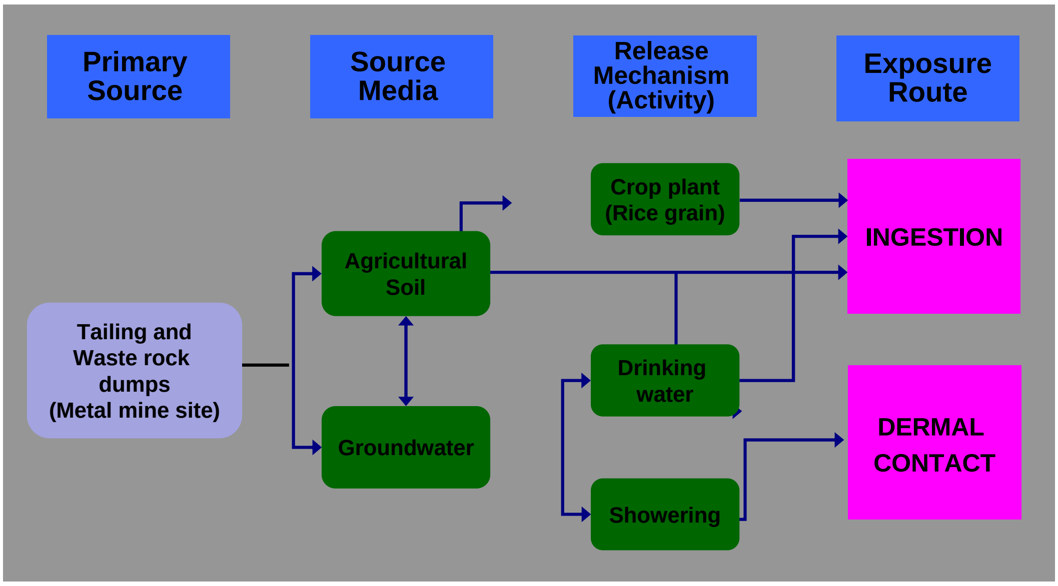
unit : mg/kg

Mines	Samples	As	Cd	Cu	Pb	Zn
Okdong (OD)	Tailings	72	53.6	910	1590	5720
	Soils	14	3.5	57	44	104
Dogok (DG)	Tailings	220	98.2	2550	4200	18020
	Soils	8	3.0	37	52	137
Hwacheon (HC)	Tailings	72	12.4	34	580	1300
	Soils	20	3.8	19	173	255

Heavy Metal Concentrations in Rice Grains and Waters

Sample type	Mine	As	Cd	Cu	Pb	Zn
Rice grain (mg/kg)	Okdong	0.17	0.12	4.1	4.1	21.2
	Hwacheon	0.23	0.16	2.2	0.1	28.3
Drinking Groundwater (mg/L)	Okdong	0.038	0.006	0.024	0.035	0.098
	Dogok	0.001	0.054	0.005	0.001	0.317
	Hwacheon	0.007	0.000	0.016	0.013	0.047

Conceptual Site Model (CSM)



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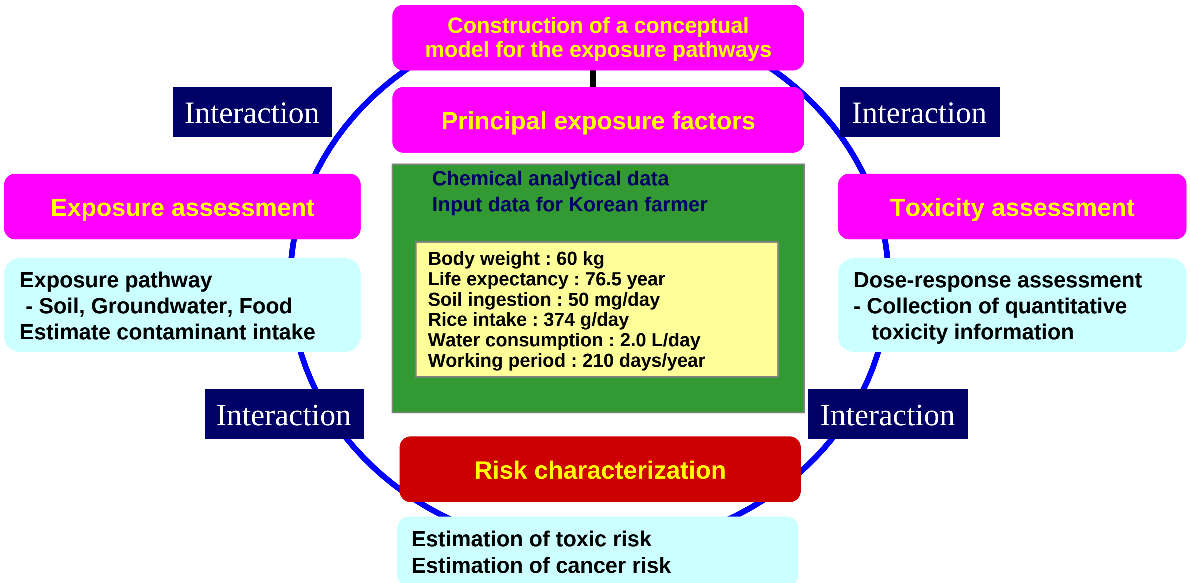
Risk Assessment Modeling



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Risk Characterization (Estimate of toxic risk)

Toxic (Non-cancer) Risk

Hazard Quotient (HQ) $= \dfrac{\textit{intake or exposure}}{\textit{reference dose}} = \dfrac{ADD}{RfD}$

Hazard Index (HI) $= ADD_1/RfD_1 + ADD_2/RfD_2 + \cdots + ADD_i/RfD_i$

$= \sum$ HQs

Risk Characterization (Cancer risk)

- Cancer risk of As according to exposure pathways

Exposure / Mine	Soil ingestion	Water ingestion	Rice grain ingestion	Soil dermal contact	Water dermal contact
Okdong	4.5×10^{-6}	7.1×10^{-4}	6.0×10^{-4}	8.8×10^{-7}	5.7×10^{-7}
Dogok	2.6×10^{-6}	1.9×10^{-5}	NR	5.1×10^{-7}	1.5×10^{-8}
Hwacheon	6.5×10^{-6}	1.3×10^{-4}	8.1×10^{-4}	1.3×10^{-6}	1.1×10^{-7}

NR : No risk for rice grain ingestion due to no cultivation of rice crops around the Dongjung and Dogok mine areas.

Risk Characterization (Toxic risk)

◆ **Hazard index (HI) and hazard quotient (HQ) for As, Cd and Zn**

Mine / Metal (Exposure)		Hazard Quotient (HQ)					ΣHQ	HI
		Soil ingestion	Water ingestion	Rice grain ingestion	Soil dermal contact	Water dermal contact		
Okdong	As	0.026	4.049	3.387	0.002	0.003	7.5	**9.0**
	Cd	0.002	0.384	0.717	0.000	0.000	1.1	
	Zn	0.000	0.010	0.422	0.000	0.000	0.4	
Dogok	As	0.015	0.107	NR	0.001	0.000	0.1	**3.6**
	Cd	0.002	3.452	NR	0.000	0.003	3.5	
	Zn	0.000	0.034	NR	0.000	0.000	0.0	
Hwacheon	As	0.037	0.746	4.582	0.003	0.001	5.4	**7.0**
	Cd	0.002	0.000	0.956	0.000	0.000	1.0	
	Zn	0.000	0.005	0.564	0.000	0.000	0.6	

NR : No risk for rice grain ingestion due to no cultivation of rice crops

Conclusion

RA is efficient tool for remediation of soil contaminated with heavy metals for determining the priority of remediation sites and scopes of remediation which are cost and time effective

Institute for Global Environmental Strategies

Towards sustainable development - policy oriented, practical and strategic research on global environmental issues

Japan's Policies and Legislative Measures for Soil Contamination Countermeasures

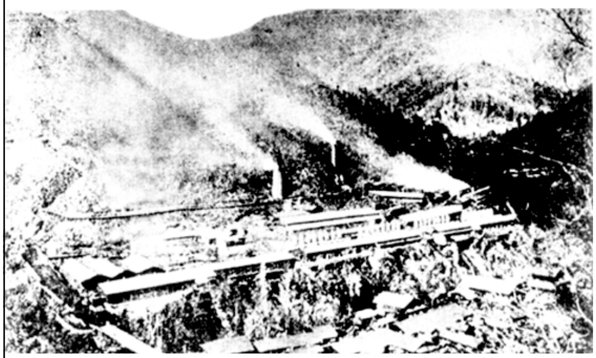
Masanori Kobayashi
Senior Coordinator
Programme Management Office

Business Meeting of
the Working group on Remediation for Soil and Groundwater Pollution of Asian Countries

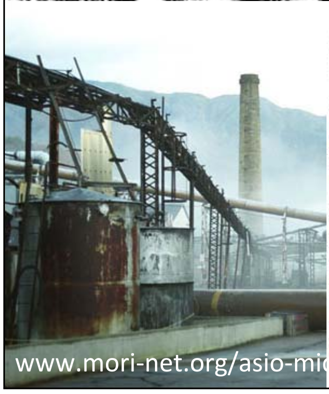
Taipei, 13 July 2011

1

Ashio Copper Mine Pollution



- Copper mining intensified in 19th Century
- Iron Oxide – Sulfuric Acid contaminated areas
- Sickness exemplified by ophthalmic disorder illness and killed over 1,000



www.mori-net.org/asio-midori.htm and others

Risk-based approaches for proper solutions

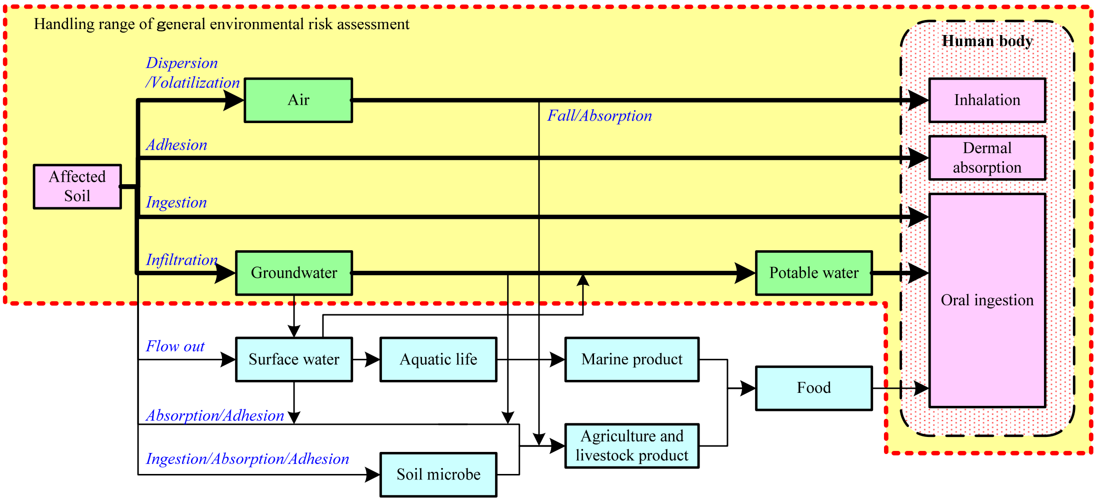
- Original goals of measures against soil and groundwater contamination
  - To reduce potential environmental risks caused by soil and groundwater contamination to an acceptable level (Reducing and controlling environmental risks).
- Risk-based measures against soil and groundwater contamination
  - To quantitatively assess and reduce potential environmental risks caused by soil and groundwater contamination.
  - To follow risk-based measures widely adopted in Europe and North America and successful in resolving brownfield issues.

3

Health risks caused by contaminated soil

- Exposure scenario for the contaminant from contaminated soil

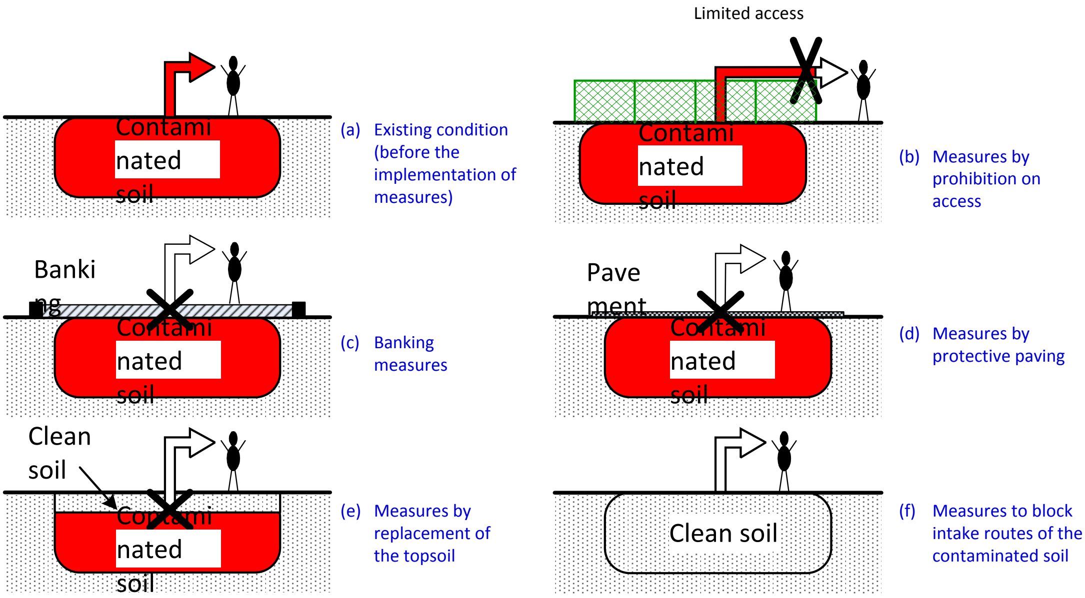
Key to block contaminant transmission or contaminant ingestion/human exposure



Source: Nakashima and Wu (2007)

4

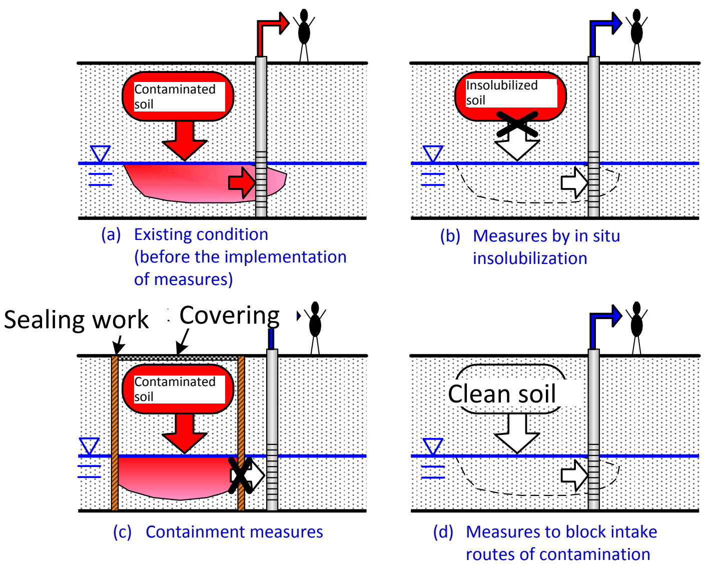
Measures to block intake routes of contamination in conformity with the Soil Contamination Countermeasures Act (Measures related to risks due to direct ingestion)



Source: Nakashima (2009)

5

Measures to block intake routes of contamination in conformity with the Soil Contamination Countermeasures Act (Measures related to risks due to ingestion of the groundwater)



Source: Nakashima (2009)

6

Contaminated Agricultural Land

- 1880's～1970s' Mineral Poison Damage of Ashio Copper Mine, Tochigi Pref. in Watarase River (Damages on rice growth, etc)
- 1910's～1970's "Itai-Itai Disease" of Jinzu River Basin in Toyama Pref. (Health Damage: Cadmium poisoning by contaminated rice, etc)
- 1920's～1960's Mineral Pollution from Toroku Mine in Miyazaki Pref. (Damage: arsenic poisoning, and rice growth, etc)

↓

In 1970, **<u>the Agricultural Land Soil Pollution Prevention Act</u>** was legislated by the Diet

The origin of Act related to Soil contamination in Japan

（at the same time, the Diet established "Water Quality Pollution Control Act" and "Waste Management and Public Cleansing Act." The Diet was called "Pollution Session of the Diet"

7

Contamination in Urban areas（1）

- In 1975, Soil contamination caused by hexavalent Chromium compounds from a site where a chemical factory closed
- In 1980's, Groundwater Contamination caused by trichloroethylene, etc becomes a social issue
- In 1986, Drawing up of "Draft Countermeasures Policy related to Soil contamination in Urban cities" by Environment Minister Agency
- In 1989, Amendment of Water Pollution Prevention Act. Regulation, that ban of facilities utilizing designated hazardous substances disseminating those substances in underground, was implemented.
- In 1991, Establishment of "Environmental Standard related to Soil Contamination (Soil Environmental Standard)"

8

- In 1994, Drawing up of “Guideline on Soil Contamination Survey and Countermeasures related to heavy-metal, etc” and “Draft Guideline on Soil and Groundwater Pollution Research and Countermeasures related to Volatile organic compounds” by Environment Minister Agency
- In 1995, Amendment of Water Pollution Prevention Act. Prefectural governor could order the polluter to clean up contaminated groundwater when this water is used for drinking.
- In 1996, Establishment of Environment Standard related to groundwater (Groundwater Environment) (adjust to Water Environment Standard in public water =clean up standard of groundwater)

Legal system of soil contamination countermeasures is not consolidated as a whole, but countermeasures based on guidelines, that are related to survey and measures for blocking intake routes of soil contaminations, through standardization conducted by Environment Minister Agency voluntary base is promoted

9

Soil Contamination caused by Dioxins

- The end of 1990’s: High concentrations of dioxins are detected from soils (around waste incinerators). Soil contamination caused by dioxins became a social issue

↓

In 1999, **the Act on Special Measures Concerning Dioxins** legislated by representatives’ Initiative

Comprehensive Countermeasures; not only for soil contamination countermeasures, but also on dioxin emissions and disposal process of dust and ash from waste incinerators

In the framework of Environmental Standard for soil contamination, it was the first time that risk assessments were implemented with regards to the direct intake of contaminated soil

10

Contamination in Urban areas（2）

- Reports of soil contamination discovery were increasing
- The rules for investigation and countermeasures were not specified
- Concerns about health damage from soil contamination

the Act on Special Measures Concerning Dioxins was established in 1999, but there were no regulations on other substances

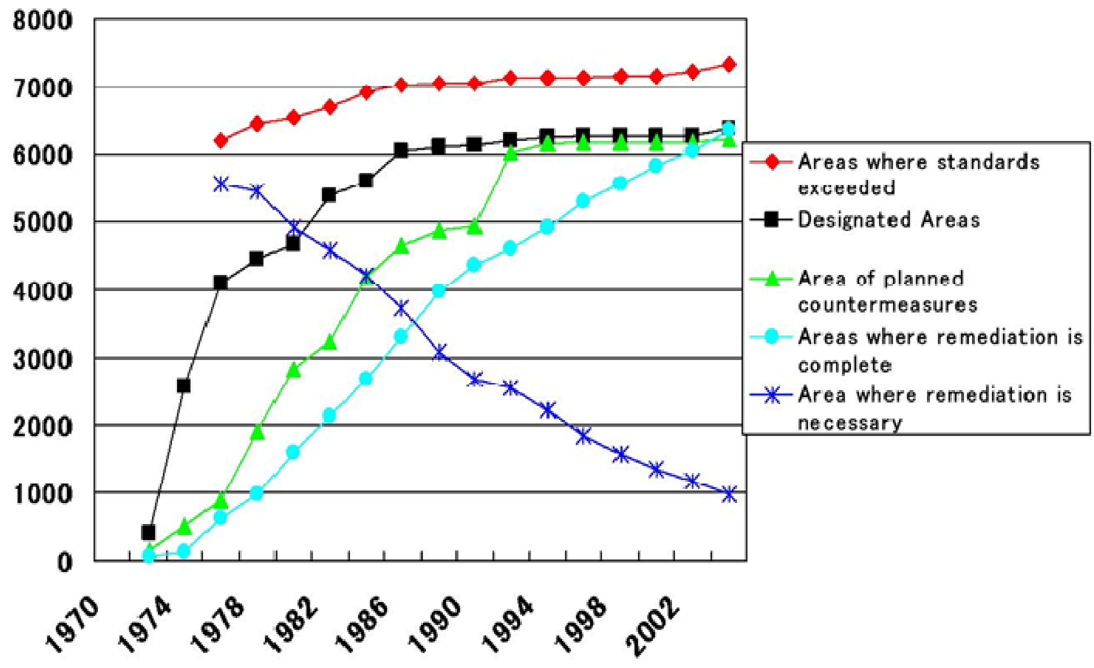
↓

In 2002, **<u>Soil Contamination Countermeasures Act</u>** was enacted at the regular Diet session

（In 2009, **<u>amendment</u>** of Soil Contamination Countermeasures Act at regular Diet session）

11

Change in the status of farmland soils since the enforcement of Agricultural Land Soil Pollution Prevention Act



MOEJ (2010)

Measures against Illegal Dumping, etc. in the Waste Management and Public Cleansing Act and other Acts

- 1971: Enforcement of Waste Management and Public Cleansing Act
  - Introduction of notification system for waste disposal facilities (structure quality standard of disposal facility construction , and operating and maintenance quality standard of disposal facility running)
  - Introduction of a system of order for actions by prefectural governors and city mayors when there are cases of illegal dumping , etc.
  - Introduction of a subrogation system (if polluters have no financial ability to conduct countermeasures)
- 1990: Case of illegal dumping in Teshima, Kagawa Pref. is raised as a major problem
- 1991: Introduction of a permission system for waste disposal facilities over a certain size (regarding landfills, all are placed under the system regardless of the size)
- 1998: If polluters are unknown or absent, and prefectural governors execute countermeasures by subrogation, the expenses are covered by a fund from the Waste Management and Public Cleansing Act (fee is based on fund (public: private =1:2), and when polluters are later identified, the expenses are billed to them)
- 2002: establishment of the Act on Special Measures for Specified Industrial Wastes (in the case of illegal disposal done before 16 June, 1998, if subrogation is implemented by governors, financial support is provided via government subsidies or special municipal bond)
- 2005: (Local budget system reformation) for cases with ministerial approval after 2006, the provision of government subsidies under the Act on Special Measures for Specified Industrial Wastes are terminated. And in Special Measures, appropriation rate of General bond for single project funding is raised to 90%
- 2009: For pre-2005 cases under the Act on Special Measures for Specified Industrial Wastes, the government has been providing subsidies directly since 2008

13

Outline of 2002 Soil Contamination Countermeasures Act

Target chemical substances (designated hazardous substances)

(1) Health impacts potential by direct ingestion of contaminated soil
e.g. heavy metals which accumulate in the surface horizon over long periods

(2) Health impacts potential by ingestion of groundwater
a soil leachate standard based on the ingestion of groundwater.

Mechanism

Investigation

・When closing down specified facilities using hazardous substances
・When prefectural governors are concerned that the possibility of human health impacts from soil contamination

↓ By landowner, site management

Investigation and reports — By designated investigation organization

↓

Designated Zone

(When soil contamination levels exceed designation quality standards)

↓

Prefectural governors designate and register on the list of designated zone for public disclosure

※ Proclamation in May 2002; Enforcement in February 2003

Outline of 2002 Soil Contamination Countermeasures Act before amendment (2)

Management of designated zone

Control of land character changes
•Notification to prefectural governors plan s about character change of land in designated zones
•If inappropriate, prefectural governors order applicant to change plans

<When the zone has the potential to case human health impacts from soil contamination>
•Where it is used as drinking groundwater in the surrounding area
•Where it is accessible to the general public

Order of Prefectural governor

Measures to block intake routes (of contamination)
the polluter* in the execution of measures.
• Measures to prevent direct ingestion: (1) area restrictions, (2) concrete capping, (3) fill, (4) replacement of soil, (5) treatment of contaminated soil
• Measures for prevent ingestion of groundwater: (1) groundwater quality control, (2) containment of contaminated soil, (3) barriers, (4) remediation of contaminated soil

Designated zones are de-registered, when remediation is completed

* The authority of prefectural governors are delegated to competent city mayor by cabinet ordinance of this Act

Implementation of measures for reducing risks in the case of health risk probability

○Soil Contamination Countermeasures Act obliges Land owner to conduct measures to block intake routes of contaminated soil in the limited case where exist human health impacts potential even when he has no negligence of soil contamination

When the land owners do not have enough financial capabilities, the government provides assistance through designated support organization.

○It is allowed that the authorities compel even no negligent landowners to conduct measures, because avoidance of public risk (=health impact potential) is required. Financial assistance is allowed by the reason to avoid public risk. Unless public risk is left unattended

Art. 8 of the Act Amendment allows land owner to demand the polluter to pay measure cost within the extent of instructed measure cost.

○There can be a case where no body is able to take measures in spite of public risk as polluters can be bankrupt or not pay enough expenses. Until polluters are identified, pollution can be left unattended despite of the health risk probability.

○Excluding land owner, polluters are not able to undertake measures that can entail land management change and no measure action can be undertaken.

○Countermeasures are for avoiding the current risk and not for seeking liability of pollution-thus, the Act doesn't require that soil be restored back to the original status prior to pollution.

Key issues raised in improving the 2002 Act

- Promoting rational countermeasures based on the type of risks
- Categorizing designated sites, and disseminating info on the status
- Assessment based on land use types
- Checking countermeasures plans
- Economic instruments
- City planners, real estate agents, accountants
- Determining an appropriate scope of the Act
- For preserving safe and comfortable land → enough to target only the health risk?
- Information sharing mechanisms
- Management sheet on removed soil
- Enforcement measures on illegal cases
- Ensuring sound treatment of removed soil
- Enhancing accuracy/credibility of surveys and countermeasures
- Prevention of soil contamination

http://www.env.go.jp/water/dojo/sesaku_kondan/rep080331/gaiyo.pdf

Outline of 2009 Amendment to Soil Contamination Countermeasures Act

Purpose

To prevent human health impact, measures for investigating situation of soil contamination, measures to block intake routes of contaminated soil, and regulation of transport and disposal of contaminated soil are established

Institution

Investigation

・When closing down specific facilities which use hazardous substances (Article.3)
・When prefectural governor receives notification for changing Characteristics of land (over 3000m2) and suspect soil contamination in this area (Article.4)
・When prefectural governor is concerned that the possibility of human health impact from soil contamination (Article.5)

Land owners can request that their own lands be designated by prefectural and city mayors when contamination is found through voluntary investigation (Article. 14)

Land owners, etc (proprietors, managers or occupants) ask specific investigation organization to implement investigation and the results are reported to prefectural governor

【When soil contamination levels exceed designation quality standards】

Zone designation

①Designated Zone for countermeasures(Article. 6)

Because this zone has the potential to cause human health impacts, measures to block intake routes of contamination are needed
→Prefectural governor instruct measures (Article. 7)
→Prohibition to change the land characteristics (Article. 9)

When intake routes of contaminants have been blocked

②Notification Zone for Changing Land Characteristics (Article.11)

Because this zone has no potential to cause human health impacts , measures to block intake routes of contamination are not needed (this includes zones where intake routes have been blocked)
→Plan notification must be submitted to prefectural governor when characteristics of soil are going to be changed (Article. 12)

When contamination remediation has been completed, the designation is withdrawn

Regulation for transporting contaminated soil

・Regulation on transporting contaminated soil from zones ① and ②
(pre-notification, plan change orders, and countermeasure orders for transfers which do not follow the transport standards)
・Duty to deliver and preserve manifests related to soil contamination
Prefectural governor permit facilities to dispose contaminated soil transported from above Zone

※Amendment of Soil Contamination Countermeasures Act is executed since 1 April. 2010 ※Contents of the amendment are shown in red colored sections
※ The authorities of prefectural governor are delegated to competent city mayor by cabinet ordinance of this Act

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MOEJ (2010)

Key changes introduced by the 2009 Amendment

(1) Restraining the excavation and removal of contaminated soil, underlining proper management of removed contaminated soil,

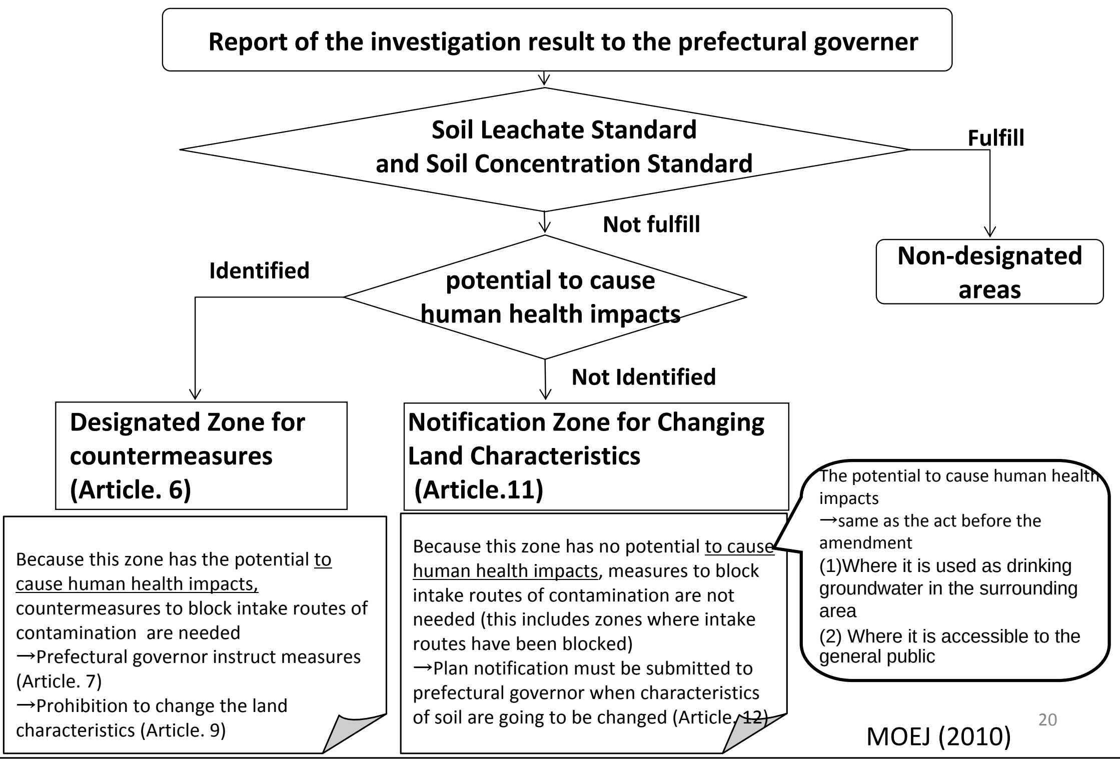
(2) Expanding the scope of the contaminated site registration systems to cover the cases of contamination revelation through voluntary investigations,

(3) Allowing the contaminated site to be removed from the list of “Designated site” and to be listed as “Notification site” when the remediation measures were undertaken to block the in-taking/exposure route (e.g., containment, embankment)

(4) Penalty for breaching the guideline of transporting contaminated soil,

(5) Requiring the contaminated soil excavation and removal the permission from the local government,

○ The designation process of “Designated Zone for countermeasures”and“Notification Zone for Changing Land Characteristics” (based on Soil Contamination Countermeasures Act)



MOEJ (2010)

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Target substances and standards

Designated hazardous substances（Article 2 of the Act）		Designation standard（Article 5 of the Act） Soil Concentration Standard ＜Risk for direct ingestion＞	Designation standard（Article 5 of the Act） Soil Leachate Standard ＜Risk of ingestion from groundwater etc.＞	Reference: Soil Environment Standard（except for copper）
Carbon Tetrachloride	category 1 (VOC)		≤ 0.002mg / L	≤ 0.002mg / L
1，2－Dichloroethane			≤ 0.004mg / L	≤ 0.004mg / L
1，1－Dichloroethylene			≤ 0.02mg / L	≤ 0.02mg / L
cis－1，2－Dichloroethylene			≤ 0.04mg / L	≤ 0.04mg / L
1，3－Dichloropropene			≤ 0.002mg / L	≤ 0.002mg / L
Dichloromethane			≤ 0.02mg / L	≤ 0.02mg / L
Tetrachloroethylene			≤ 0.01mg / L	≤ 0.01mg / L
1，1，1－Trichloroethane			≤ 1mg / L	≤ 1mg / L
1，1，2－Trichloroethane			≤ 0.006mg / L	≤ 0.006mg / L
Trichloroethylene			≤ 0.03mg / L	≤ 0.03mg / L
Benzene			≤ 0.01mg / L	≤ 0.01mg / L
Cadmium and its compound	Category 2 (Heavy metal etc.)	≤ 150mg / kg	≤ 0.01mg / L	≤ 0.01mg / L, and ≤ 1mg / 1kg rice on agricultural field
Hexavalent Chromium compounds		≤ 250mg / kg	≤ 0.05mg / L	≤ 0.05mg / L
Cyanides compounds		As isolated cyanides ≤ 50mg / kg	Less than detection limit	Less than detection limit
Total Mercury and its compounds		≤ 15mg / kg	≤ 0.0005mg / L	≤ 0.0005mg / L
Alkyl Mercury			Less than detection limit	Less than detection limit
Selenium and its compounds		≤ 150mg / kg	≤ 0.01mg / L	≤ 0.01mg / L
Lead and its compounds		≤ 150mg / kg	≤ 0.01mg / L	≤ 0.01mg / L
Arsenic and its compounds		≤ 150mg / kg	≤ 0.01mg / L	≤ 0.01mg / L and ≤ 15mg / kg soil on rice field
Fluorine and its compounds		≤ 4000mg / kg	≤ 0.8mg / L	≤ 0.8mg / L
Boron and its compounds		≤ 4000mg / kg	≤ 1mg / L	≤ 1mg / L
Simazine	Category 3 (Agrochemicals and PCBs)		≤ 0.003mg / L	≤ 0.003mg / L
Thiuram			≤ 0.006mg / L	≤ 0.006mg / L
Thiobencarb			≤ 0.02mg / L	≤ 0.02mg / L
PCB			Less than detection limit	Less than detection limit
Organic phosphorus compounds			Less than detection limit	Less than detection limit

MOEJ (2010)

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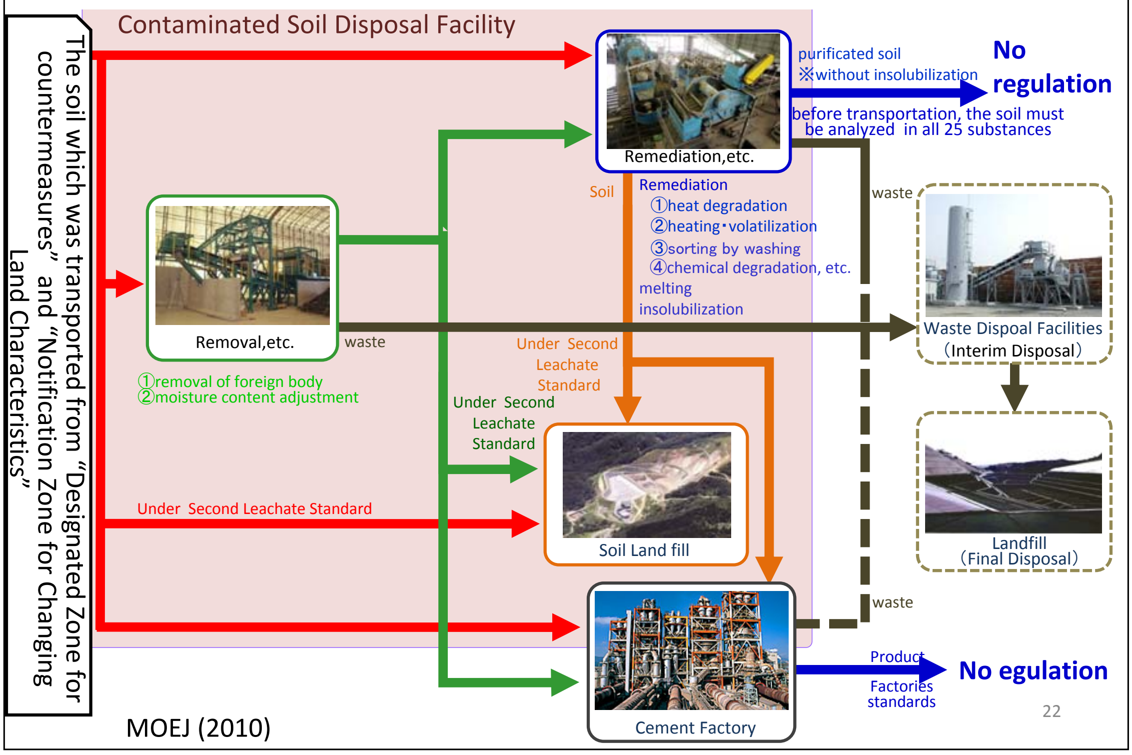
○ Contents of the disposal of the contaminated soil and the definition of the facility



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Improvement for Reliability of designated investigation organizations

○ Introduction of designated renewal plan (If renewal plan would be taken every 5 years, designation would be expired)

※designated investigation organizations that have already been designation before the amendment, they are considered as designated organizations that are designated after the amendment, on 1st of April, 2010.

○ To set up the position of technological managers, and to establish the duty for observation responsibilities by technological managers (technological managers who passed the examination implemented by minister of environment)

※In designated investigation organizations before the amendment, person who manages technologies, based on ministry ordinance before the amendment, are identified as technological managers until 31st of March, 2013.

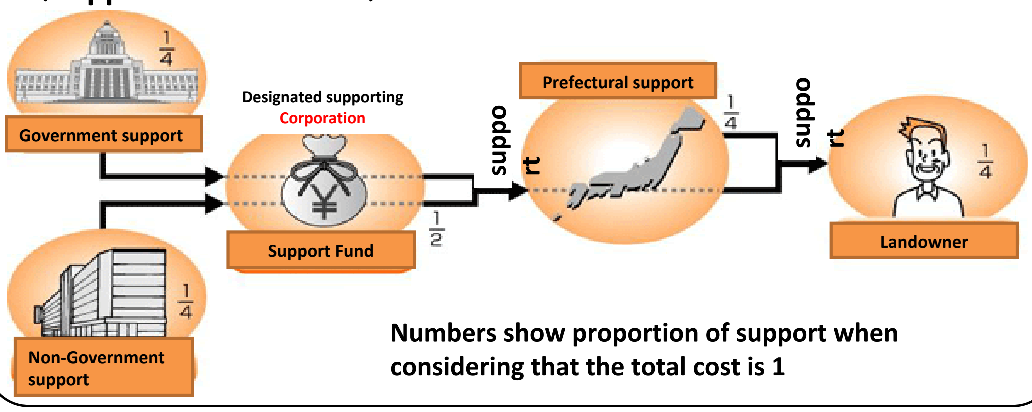
○ To tighten designated standard for designated investigation organizations (To set up the appropriate position for technological managers)

○ To establish duties for improving contents of business processes, and attach ledger sheets, and others

○ Financial support from the Soil Contamination Countermeasures Fund

-The designated zone land owner who is order to take counter-measures/remediation measures must not be the polluter.
- Such a land owner does not have sufficient financial resources,
- Prefectural government provides 1/4 of cost for the counter/remediation measures to be supplemented by the Soil Contamination Countermeasures Fund,
- So far only 1 case funded under this scheme,
- Only two local governments have provisions on co-financing measures (as of Aug, 2010).

<Support Fund Scheme>



Numbers show proportion of support when considering that the total cost is 1

MOEJ (2010)

○ The Flow of Soil Contamination Investigations

①Verification of the Investigation Target areas and Target Substances

②Classification of Contamination Risks

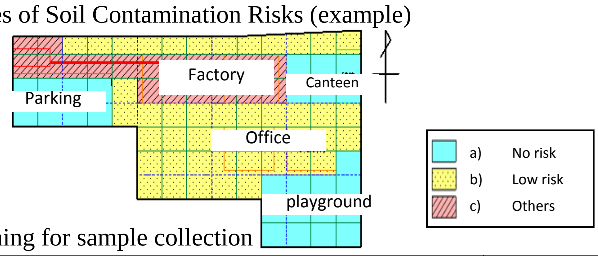
③Zoning for sample collection

④Measurements and Analyses

⑤Evaluation of Contamination status and reporting

Nakashima (2009)

②Categories of Soil Contamination Risks (example)



③Land Zoning for sample collection

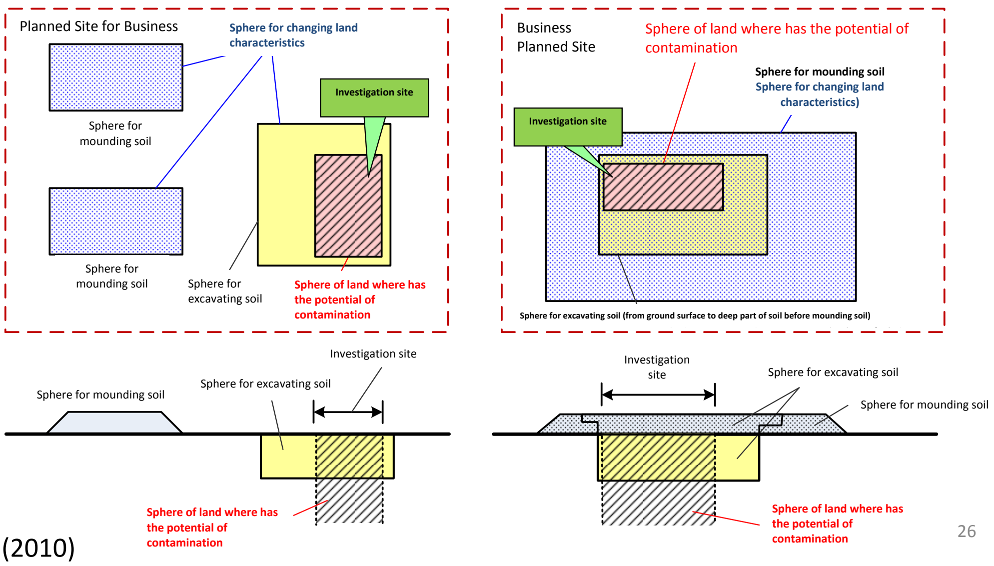
Categories		Collection method
(a) No risk of Soil Contamination	Land that is independent and isolated from the organisations using Designated Hazardous Substances. (ex) mountains and forests, staff accommodation, sports grounds, etc	No need for samples
(b) Low Contamination Risk	The land is not directly used for Soil Contamination Countermeasures, but may be under the influence of other facilities using Designated Hazardous Substances. (ex)Offices, Storages, Gardens, and areas not connected to the facilities using Designated Substances.	Collect samples from one spot or 5 spots within zones of 30m by 30m . (Every 900㎡) Note: VOC needs one sampling and heavy metals need 5.
(c) Others	(ex) Buildings accommodating facilities for the use of Designated Hazardous Substances, pipelines connected to them.	10m by 10m sampling method

④Measurements and Analyses

The collection of documents	Measurement methods
Investigation of gas emissions from soil	The designation of methods for investigating gas emissions (6 March 2003 MOEJ announcement n.16)
Investigation of Soil Elution Levels	The designation of methods for investigating elution (6 March 2003 MOEJ announcement n.18)
Investigation of elements contained in the Soil	The designation of methods for investigating soil contents (6 March 2003 MOEJ announcement n.19)

Article 4. Specific Plot for Investigation

○Sphere of land where; (1) characteristics of land would be changed, (2) is planned to excavate, and (3) Prefectural governor identifies the land has the potential of contamination.



MOEJ (2010)

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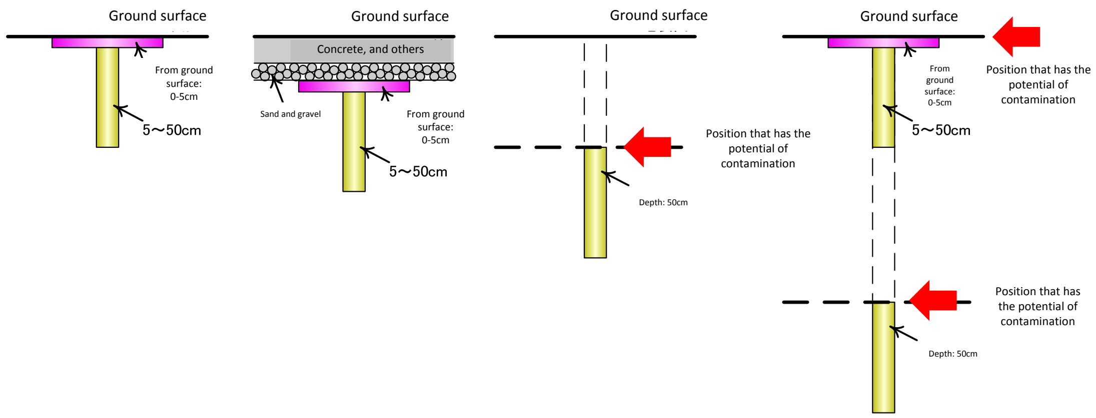
Depth for soil sampling extractions (except for soil gas investigation)

○To implement sampling extractions, but the place where has the potential of contamination should be taken into account (within 10m in depth)



MOEJ (2010)

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(3)Process of voluntarily investigation for Removing soil

To excavate soil at **Designated Zone for countermeasures** and **Notification Zone for Changing Land Characteristics**

Legal compliance (in the case that voluntarily investigation is not implemented)

In the case for implementing voluntarily investigation

Investigation of excavated soil

Implementation approach

【case of investigation before excavation】

① To classify sphere of excavating land into 10m mesh

② To do boring to the depth for excavation, and to pick up soil for 1m each

③ To analysis all specific harmful substances

【case of investigation after excavation】

①To classify excavated soil into less than 100m3 unit

② To pick up soil at five focal points voluntarily where are already classified, and mix them up (VOC is picked up soil at 1 focal points)

③ To analysis all specific harmful substances

＊After containment, investigation has not been implemented for a long time

Nonconformity of standard → To report "taking out of contaminated soil" to Mayor of Prefectural governor → Taking out as contaminated soil → Transferring and disposal as contaminated soil

Conformity of standard → To report "soil that conforms the standard" to Mayor of Prefectural governor → Certification by mayor of Prefectural governor → Taking out as soil be exempt from the regulation

Land that investigation process is omitted, because the soil condition is already contaminated, can be dealt with non-contaminated soil , if omitted investigation process is implemented when contaminated soil is removed

MOEJ (2010)

Japan's Soil Contamination Countermeasures Act Performance (Before amendment: Feb. 2003 – Feb 2008)

Surveyed sites 898 cases

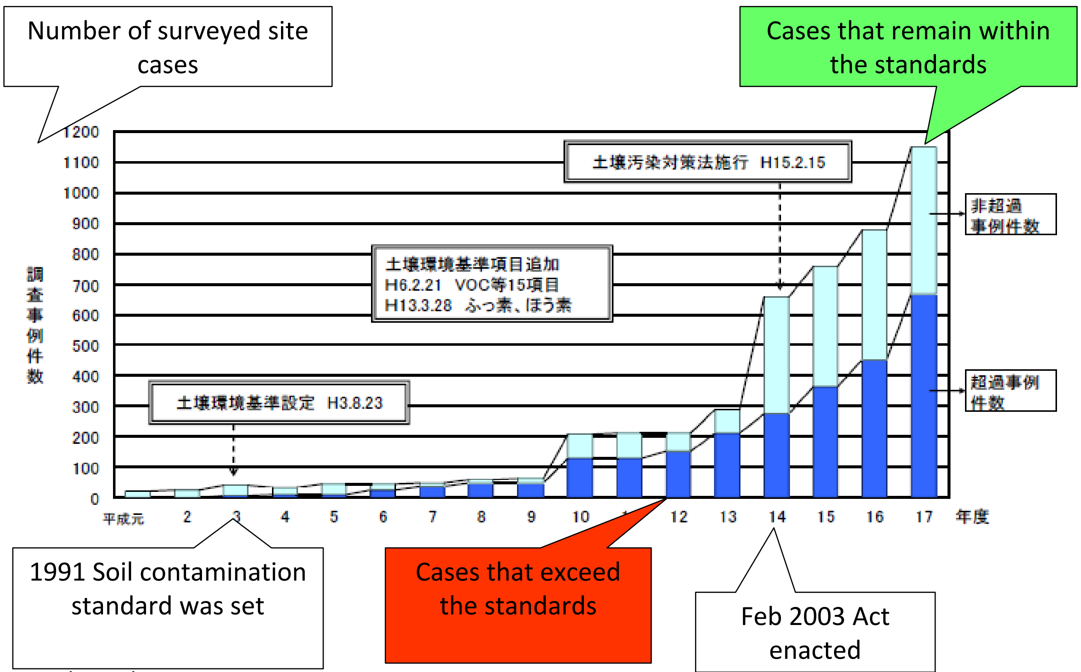
Designated sites 259

Sites declared to require contamination removal 63 (33 removed, 30 in the process of removal or under consideration, 0 – no action)

Sites declared not to require contamination removal
W196 (111 treated, 62 in the process of treatment or under consideration, 23 – no action)

Lifting the designation of sites under the Act 128

Surveyed site cases

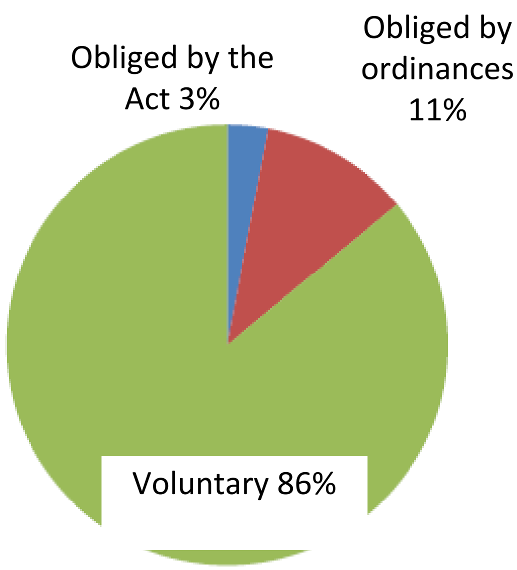


MOEJ (2010)

Number of surveys in 2006

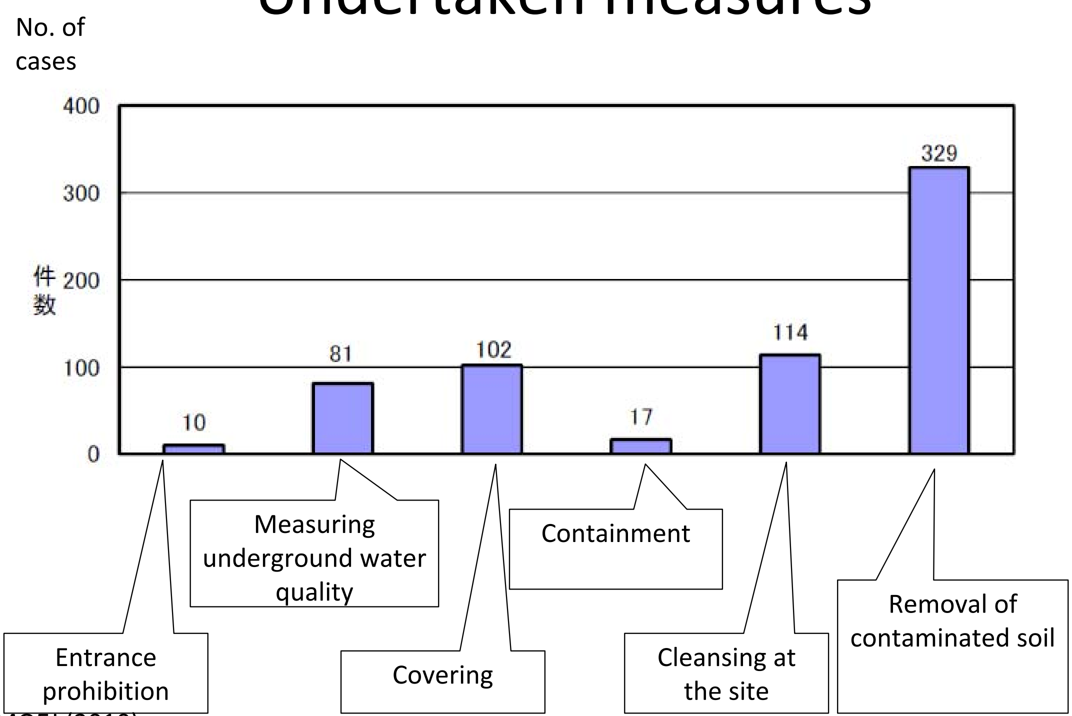
Surveyed

14,032 cases



MOEJ (2010)

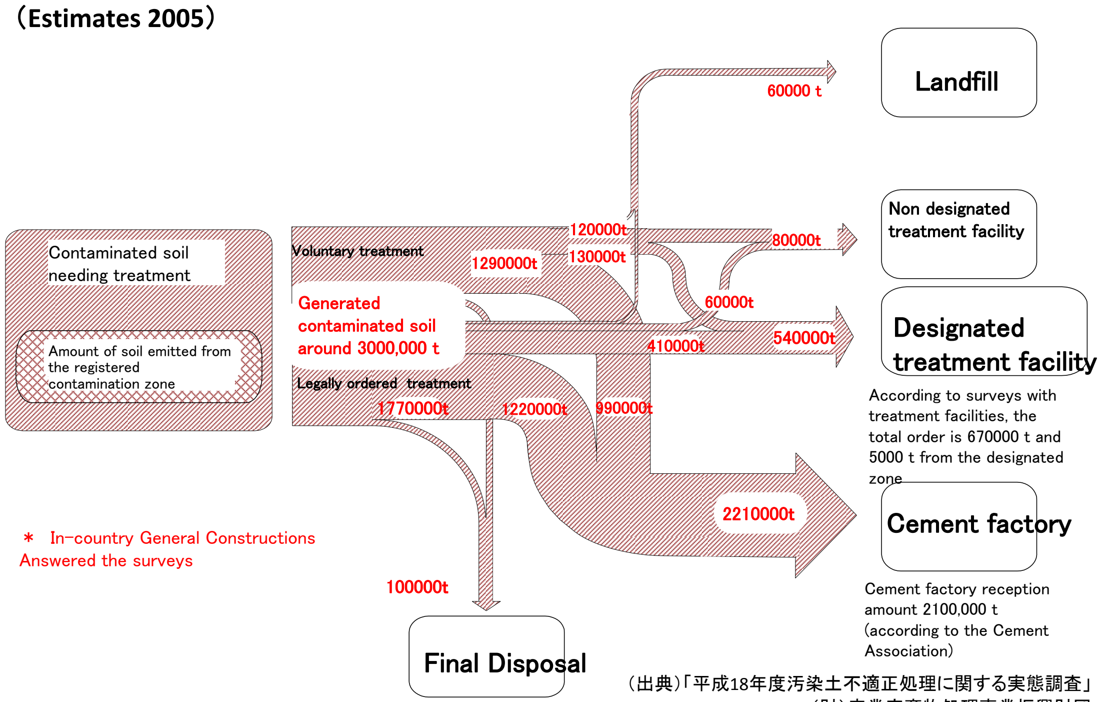
Undertaken measures



MOEJ (2010)

○ The flow of contaminated soil (Problem after legislation)

（Estimates 2005）



（出典）「平成18年度汚染土不適正処理に関する実態調査」
（財）産業廃棄物処理事業振興財団
Source: The Waste Management Fund (2005)

○ Inappropriate treatment of contaminated soil

According to the data from the regional governments, there are many cases of inappropriate treatment of contaminated soil as can be seen in the following:

①Hexavalent chromium contaminated soil was abandoned (July 2006)
Hexavalent chromium was detected from the soil dumping site and despite the municipal request to rehabilitate the area, nothing was done. Now the buyer of the land is dealing with the soil contamination countermeasures

Contaminated soil 15,000

②Mercury contaminated soil (November 2003)
Mercury contamination occurred at a thermometre manufacturing centre. The soil was planned to be treated at appropriate facilities but in reality was transported elsewhere to undergo the melting process.

The manufacturers had planned to treat 250m2

③Arsenic-contaminated soil (October 2003)
Arsenic exceeding the standards was detected in a soil storage mound.

MOEJ (2010)

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Challenge one: Stakeholder coordination and partnership

Differing preoccupations of key actors/stakeholder groups

MOEJ

- Reducing overall environmental/health risk (pollutant transmission, proliferation of polluted soil) → pollution containment is an immediate action

Local government

- Trying to introduce more strict reporting requirements on land use change through the local ordinance than the national Act (3,000 h.a. under the Act vs possibly 1,000 h.a. in local ordinance)

Business

- Sustaining real estate value (buyers' perception is more important than actual environmental risk)

Civil society

- Access to information, Reducing public cost

➡ Capturing major interests and finding common grounds while noting difference

Challenge Two: Identifying and synthesizing good practice

A. Living on the contained contaminated soil?

↓

Containment of polluted soil/ risk communication

- Safe,
- But some feel uneasy,
- Reluctance to disclosing information to the public

Ideal approach

B. Living on the cleaned soil?

↓

Technology for cleansing contaminated soil

- Uneasiness diminishes,
- But costly,
- Risk of polluted soil proliferation

Reality

Suggested practice not yet widely implemented, difficult to access info/interact with stakeholders

Recent lawsuit case – Seiko Epson vs Ohji Paper

SE bought land from Ohji Paper and it turned out that the soil was contaminated with dioxin and PCB (Polychlorinated Biphenyl).

SE estimates that 9,200 tons of contaminate soil would require removal/cleansing

SE have taken measures to remove/cleanse contaminated soil

SE sought 640 million JPY(6.4 million USD) for damages

The court ruled on 8 July 2008 that Ohji must pay 589,75850 (5.9 million USD)

Adachi Ward Land Development Authority vs AGC Seimi Chemical

Adachi Ward LDA bought land from AGC SC bought 3,600 m2 at JPY2.3 billion (USD23 million) in 1991. In 2005, it turned out the level of fluorine was over the regulatory standard introduced in 2003.

Tokyo Lower court ruled in favor of AGC SC.

On 26 September 2008, the Tokyo High court ruled in favour of Adachi Ward LDA stating that AGC SC must pay JPY449 million.

This ruling was seen as epoch making in a sense that the chemical that is not regulated at the time of land transaction can be a cause of liability at the later stage when the chemical is provided as toxic in the legislation.

The current legislation designate 26 substances as toxic, but this list may grow in the future and land owner/seller must undertake an precautionary measures to reduce soil contamination or remove contamination.

The proposed relocation of Tsukiji Fish Market to Toyosu

Tsukiji, Over 70 years old – biggest fish market of the world

Proposed relocation to Toyosu – 2 km away to the land that used to be a factory of Tokyo Gas

1. In 1999, a newly elected governor announced the relocation as it has become "old, dirty and small."
2. In 2008, it was discovered that benzene is contained in the soil at the level of over 43,000 times more than the regulatory standard.
3. The cost of cleaning is estimated at JPY67 billion jumped from JPY130 billion of the original estimate.

www.esco-architects.co.jp

Wednesday, March 7, 2007 Japan Times

NEW SITE UNHEALTHY, CRITICS CHARGE

Tsukiji fish mart relocation plan draws toxin gripes

By MASAKO OZAKI
Kyodo News

Relocating Tsukiji market, home to the world's largest fish bazaar, is not as easy as transporting a box of tuna from one wholesaler to another by pallet truck.

It is clear that nobody is in a rush as the middle traders move around on their mini-trucks through the market in the heart of Tokyo.

And although the metropolitan government has decided on the relocation and plans to finish construction by 2012, the plan has hit a snag, due partly to environmental concerns at the proposed relocation site on Toyosu wharf.

Wholesalers cross the bustling Tsukiji market recently, where fish is distributed for Tokyo and the rest of the country. KYODO PHOTO

→ Relocation plan in on-hold due to the opposition to the plan

Other landmark recent cases and news on soil contaminations

• Tokyo District Court ruled to order the land seller to pay JPY 590 million for the cost of treating sol contaminated with dioxin (8 July 2008),

• Supreme Court revoked the ruling of the High Court and ruled that the land buyer doesn't assume responsibility for soil contamination with Fluorine that was not regulated at the time of land sale transaction. Tokyo District Court rejected the claim by the land buyer, but the High Court ruled for the land seller to pay for JPY448,900 million (1 June 2010)

• Mangers of the real estate developers were investigated and the police reports were sent to the Prosecutors Office based on the violation of the Building Lots and Buildings Transaction Business Act for selling the apartment units by concealing the fact of soil contamination. (30 March 2005)

• The Ministry of Defense disclosed that the maximum of 30 times lead from the permissible standard was found in the site of the former foreign military base in Yokohama (30 June 2010)

•The Weekly Magazine reported on soil contamination in residential areas in Tokyo (8 July 2010)

➡ Increasing public awareness through court ruling, policy investigation and media coverage – developing policy and social issues

Observation and future challenges for effective soil contamination countermeasures

• Improving the policy performance on policy and legislative measures for preventing pollution,

• Enhancing the public understanding on the environmental soundness of various countermeasures,

• Ensuring compliance with the guidelines for treating excavated contaminated soil,

• Ensuring the proper management of the directory of the designated sites and notification sites,

• Promoting activities on environmental risk communication,

• Developing the cost-sharing schemes for counter/remediation measures particularly those substances that were post facto designated as toxic,

• Sharing good practices and lessons with other countries

Conference on
Human Health Risk Assessment of
Soil and Groundwater Contaminated Sites

June 14
2011

Location

MRT

Danshui/Beitou (Red line):

Exit 2, National Taiwan University Hospital Station

Blue Line:

Exit 2, Shandao Temple Station

Bus Stop

MRT Shandao Temple Station：

0(south)/15/22/202/212/212(straight)/220/232/232/257/262/265/299/605/671

MRT NTU Hospital Station:

22/15/615/227/648/648(green)/208/208(straight)/37

Conference on
Human Health Risk Assessment of
Soil and Groundwater Contaminated Sites

June 14
2011

List of Participants

(Listed on June 8, 2011)

International Participants

Surname	First Name	Country	Institute Organization
Bahari	Azimuddin	Malaysia	Ministry of Natural Res. and Environ.
Beamer	Paloma	USA	U.S. Environ. Protection Agency
Bradham	Karen D.	USA	U.S. Environ. Protection Agency
C. Concepcion	Edwin	Philippines	Department of Environ. and Natural Res.
Ells	Stephen John	USA	U.S. Environ. Protection Agency
Greenberg	Marc Samuel	USA	U.S. Environ. Protection Agency
Hanh	Pham Thi Thuy	Vietnam	Ministry of Natural Res. and Environ.
Hasan	Rashid	India	Ministry of Environment and Forests
Jr	Ernesto D. Adobo	Philippines	Department of Environ. and Natural Res.
Kim	Dong Jin	Korea	Ministry of Environment
Kobayashi	Masanori	Japan	Inst. for Global Environ. Strategies
Le	Le Thi Hai	Vietnam	Ministry of Natural Res. and Environ.
Makino	Tomoyuki	Japan	National Inst. for Agro-Environ. Sciences
Mills	Marc Allyn	USA	U.S. Environ. Protection Agency
Mohd Rapi'Ain	Nur Sharliza	Malaysia	Ministry of Natural Res. and Environ.
Nursyamsi	Dedi	Indonesia	Indonesian Agric. Environ. Res. Inst.
Purnama	Aep	Indonesia	State Ministry for Environment
Sitthichai	Aroonkit	Thailand	Ministry of Natural Res. and Environ.
Troche	Luis Alberto	USA	U.S. Environ. Protection Agency
Wangcharoenrung	Chayawee	Thailand	Ministry of Natural Res. and Environ.
Yang	Jae E.	Korea	Kangwon National University
YI	Jin Won	Korea	Ministry of Environment

Local Participants

Surname	Given Name	Chinese Name	Institution
Chang	Yi-Tang	張怡塘	Soochow University
Chang	Ariel	張欣欣	Alterra technical Corporation
Chang	Li-Wen	張力文	Sitech Services, Inc.
Chang	Keng-Jung	張耿榕	TESC
Chang	Wen-Hsin	張文馨	TESC
Chang	Hao-Yen	張顥嚴	National Taiwan University
Chen	Hsin-Jung	陳信榮	China Steel Corporation
Chen	I-Chun	陳怡君	Industrial Technology Research Institute
Chen	Ching-Yu	陳慶宇	China Environmental Consultants Limited
Chen	Mei-Kuei	陳梅桂	National Taiwan University
Chen	Shen-Yi	陳勝一	National Kaohsiung First University of Science and Technology
Chen	Ching-Yuan	陳敬遠	MEIHO University
Chen	Chiu-Yang	陳秋楊	Ming Chi University of Technology
Chen	Sara	陳虹螢	GITech
Chen	Yue-Sen	陳躍升	FORMOSA PLASTICS CORPORATION
Chen	Yi-Han	陳薏涵	TWEPA
Chen	Zueng-Sang	陳尊賢	National Taiwan University
Chen	Yang-Min	陳彥旻	Sustainable Environment Research Center
Cheng	Shu-Fen	程淑芬	Chao Yang University of Technology
Cheng	Hsiao-Fen	鄭曉芬	Industrial Technology Research Institute (ITRI)
Chin	S-Len	秦詩漣	Billion Beauty Engineering Technologies, Inc.
Chin	Lieng-Chieh	金良杰	Weston Solutions Taiwan, Ltd.
Chiu	Wei-po	邱韋博	National Dong Hwa University
Chiu	xiu-ling	邱秀玲	Farm Irrigation Association of Kaohsiung
Chou	His-Ling	周希瓴	Soochou university
Chou	Chih-Hao	周志豪	Jinn Wei Engineering & Construction Co., Ltd
Chu	Jerry	朱家毅	URS International Projects, Taiwan Branch
Chuang	Chien-Tsai	莊見財	FORMOSA PLASTICS CORPORATION
Chung	David	鍾朝義	Bureau Environmental Protection, Keelung City
Fan	Joseph	范康登	MWH Taiwan Office
Fan	Huei-Ru	范惠茹	National Taiwan University
Fen	Chiu-Shia	馮秋霞	Feng Chia University
Go	Ching-LIn	郭青霖	Feng Chia University
Ho	Chung-Ying	何宗穎	Environmental Protection Adminstration Executive Yuan, R.O.C
Hsiao	Chia-Ning	蕭家寧	CENPRO TECHNOLOGY CO., LTD.
Hsieh	Chi-Ying	謝季吟	National Pingtung University of Science and Technology
Hsu	Chum-Ming	許峻銘	CHINA ECOTEK CORPORATION
Hsu	Hui-Tsung	許惠悰	China Medical University
Hu	Chi-Chien	胡智傑	National Taiwan University
Huang	Chih-Hui	黃稚惠	National Taipei University of Education
Huang	Fu-Chang	黃富昌	Nanya Institute of Technology
Huang	Chih	黃智	Sinotech Engineering Consultants, Inc.
HUANG	SHIH-HAN	黃士漢	EPA

Huang	Tai-Xiang	黃泰祥	National Taiwan University
Huang	Cheng-Chieh	黃正介	National Taiwan University
Hung	Hao-Chun	洪豪駿	TWEPA
Kao	Yi-Feng	高逸峰	SINOTECH ENGINEERING SERVICES, LTD.
Lai	Yi-Sin	賴宜欣	Sinotech Engineering Consultants, Inc.
Lai	Ting-Hsiang	賴英吉	Guan Cheng Enviro Tech Protection Co., Ltd.
Lee	Dar-Yuan	李達源	National Taiwan University
Lee	Chen-Chang	李禎常	CHC Resources Corporation
Lee	Chia-wei	李嘉偉	National Taiwan University
Lee	Jyuhn-Hsiarn	李俊賢	National Health Research Institutes
Lee	Chia-Hsing	李家興	National Taiwan University
Li	Xiao-Lan	李曉嵐	APOLLO TECHNOLOGY CO., LTD
Li	Louise	李芸英	ERM-Taiwan
Liang	Chiu-Ping	梁秋萍	COA
Liao	Pao-Yun	廖保雲	TWEPA
Liao	Pei-yu	廖珮瑜	MWH
Lin	Shu-Hsin	林淑鑫	TASGEP
Lin	Shu-Yu	林書羽	MWH Taiwan
Lin	Ling-Chu	林玲珠	National Central University
Lin	Chi-Yen	林季燕	National Taiwan University
Lin	Wei-Chou	林威州	Sinotech Engineering Consultants Ltd.
Lin	ming-chang	林明錩	Bureau Environmental Protection, Hsin-Chu City
Lin	Lisa	林孟秋	Bureau Environmental Protection, Taoyuan County
LIN	TZU-YUN	林子筠	MANAGER
Liu	Chih-Chung	劉志忠	Sinotech Engineering Consultants Ltd.
Liu	Jung-Hsiu	劉蓉袖	Feng Chia University
Liu	Ching-Lung	劉錦龍	National Science Council
Lo	Y Cheng	羅奕晟	Bureau Environmental Protection, Taoyuan County
Lu	Che-Ming	盧哲明	SGS TAIWAN LIMITED
Ngo	Thi-Thuan	歐婷芳	National Central University
Ni	Chuen-Fa	倪春發	National Central University
Ou	Chiao-Yi	歐喬宜	National Taiwan University
Pan	Shih-Cheng	潘時正	Sinotech Engineering Consultants Ltd.
Sah	jy-gau	薩支高	National Ping-Tung University of Science and Technology
Shan	Hsin-yu	單信瑜	National Chiao Tung University
Shen	Chien-Chuan	沈建全	National Kaohsiung
Shih	Yang-Hsin	施養信	National Taiwan University
Su	Shih-Chang	蘇世昌	KATEC R&D Corp.
Tsai	Chia-Ying	蔡佳穎	National Dong Hwa University
Tsai	Cheng-Chi	蔡呈奇	National Ilan University
Tsai	Wan-Ying	蔡婉楹	Sinotech Engineering Consultants, Inc.
Tsai	Kuo-Sheng	蔡國聖	Bureau Environmental Protection, Keelung City
Tsai	Yun-Da	蔡昀達	Sinotech Engineering Consultants,ltd.
Tseng	Li-Hsuan	曾立軒	China Medical University
Tsui	Lo	崔砢	Mingchi University of Technology

Tsui	Chun-Chih	崔君至	National Taiwan University
Tsui	Chia-Chi	崔家綺	National Taiwan University
Tu	Dennis	涂震江	URS/Scott Wilson China
Tung	Te-Chih	董德志	Industrial Technology Research Institute
Tzou	Leon	鄒倫	CTCI Foundation
Wang	Andy	王聖斐	Merck Ltd.
Wang	Jun-Yu	汪俊育	China Steel Corporation
Wang	Wei-Chi	王瑋琦	China Medical University
Wang	Chang	王彰	Glory Engineering & Technology
Wang	Mei-Sheue	王美雪	Vanung University
Wang	Zih-Sin	王子欣	TWEPA
Wang	James		CETCO
Wang	Chien-hui	王倩卉	Tainan Hydraulics Laboratory,NCKU
Wei	Hsien-Hsiang	魏顯祥	Sinotech Engineering Consultants Ltd.
Wu	Ming-Yen	吳明諺	PIN-PRO CORPORATION
Wu	Ni-Yen	吳妮晏	Council of Agriculture
Wu	Chao-Kai	吳兆凱	MWH Taiwan
Wu	Dickson	吳添貴	Helpful Machinery Service Ltd.
Wu	Jun-Wei	吳俊偉	
Wu	I-Min	吳一民	China Steel Corporation
Yan	Ren-rong	顏瑞容	Alterra technical Corporation
Yang	Hui-Wen	楊惠雯	FCU EES
Yang	Tzong-Deng	楊宗燈	FORMOSA PLASTICS CORPORATION
Yang	jin-xiong	楊晉雄	Bureau Environmental Protection, Keelung City
Yu	Yi-Hsien	余奕賢	National Dong Hwa University
Yu	Cheng-Kang	余政剛	GITech
Yuan	Yu-Kang	袁又罡	National Yunlin University of Science & Technology

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East and Southeastern Asian Countries on
Soil and Groundwater
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