Comparison of the Soil Environment Conservation Act and the Groundwater Act in the Republic of Korea

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Abstract

Demand for water is steadily rising due to high population growth coupled with continuing urbanization and industrialization. Limited surface water availability makes water supplies increasingly dependent on groundwater. With growing dependence on groundwater, groundwater quality and availability are becoming an increasingly important issue. Once groundwater is contaminated, pollutants rest in the contaminated aquifer semi-permanently, requiring enormous efforts and costs for remediation, apart from the fact that it is technically impossible to restore contaminated water to its natural state. Therefore, the importance of preventing groundwater contamination cannot be overstated. In this regard, it is of paramount importance for sustainable and efficient management of groundwater resources to regulate it with clearly formulated provisions in pertinent laws and regulations. Worldwide, groundwater remediation is usually done in conjunction with soil remediation. In the Republic of Korea, too, groundwater remediation is performed mostly as part of soil remediation projects. In this study, we compare and analyze two domestic laws directly associated with groundwater remediation, namely, the Soil Environment Conservation Act and the Groundwater Act. On the basis of the analysis results, we sought strategic measures for strengthening nationwide groundwater quality management.

Keywords: Groundwater Act; Groundwater quality management; Groundwater remediation; Soil Environment Conservation Act

Introduction

The natural environment is the common asset of all citizens and must be conserved to best serve the public interest and used in a sustainable manner for the present and future generations. The environment is destroyed or suffers lasting deterioration for a variety of reasons, with the greatest proportion attributable to human activities (Pelling, 2003). Although there are other causes of environmental degradation, such as air pollutants emitted from volcanoes (Robock, 2000) and naturally caused forest fires (Stojanova *et al*., 2012), they make up only a small proportion of environmental degradation compared with anthropogenic sources.

A wide range of environmental issues such as water quality (Peters & Maybeck, 2000; Douglas, 2003), atmosphere (Vitousek *et al*., 1997), ecosystems (Jordanova *et al*., 2008), soil environment (Jordanova *et al*., 2008; Meena *et al*., 2011), and marine environment (Harvell *et al*., 1999) arise from environmental degradation (Smith *et al*., 1999). Nature can tolerate environmental pollution up to a certain degree through its self-cleaning function (Barnes *et al*., 1999). However, pollution beyond the point that allows nature's self-cleaning processes begins to degrade the environment, changing it into a state threatening the survival of living things. Therefore, we have to seek appropriate measures to ensure the coexistence of nature and humans by keeping the environment from further degradation. Driven by this need, the government has been regulating and controlling environmental pollution by enacting and enforcing relevant laws and regulations (Birnie & Boyle, 1994).

In the Soil Environment Conservation Act (SECA), soil contamination is defined as 'contamination of soil caused by business or other human activities, damaging the health and property of people or the environment' in Article 2(1), and preventive measures against soil contamination are laid down in Article 15. The Act §15-3 and Article 10 of the Enforcement Decree of the Soil Environment Conservation Act (SECA-ED) stipulate the soil remediation methods and standards. The relevant risk assessment is prescribed in the Act §15-5 and SECA-ED §19(3) and (4), and the verification of soil remediation in the Act §15-6 and SECA-ED §19(7). Detailed methods and procedures are presented separately in the Guidelines for Contaminated Soil Remediation Technologies (2007) and the Guidelines for Soil Contaminants' Risk Assessment (2009) (Ministry of Environment, 2002, 2007, 2009).

In the Groundwater Act (GWA), whereas 'groundwater' is defined as 'water filling or flowing through spaces between strata or rocks beneath the earth's surface' (GWA §2.1), the definition of 'facilities causing groundwater pollution' (GWA §16-2) is vicariously used as the definition of groundwater contamination. Nor does the GWA have any provisions for direct and concrete orders and methodologies regarding remediation of contaminated groundwater. Instead, the Enforcement Decree of the Groundwater Act (GWA-ED) prescribes 'purification of polluted groundwater' as one of the 'measures with respect to managers of facilities causing groundwater pollution' [GWA-ED §26-3(4)] (Ministry of Environment, 2018).

Furthermore, GWA §15(1)4 prescribes that where groundwater cannot be developed and used due to poor water quality, the related facilities and land must be restored to the original state after the pertinent permission or approval is obtained. By defining 'restoration to the original state' as 'dismantlement of facilities or the proper reclamation of land in order to prevent the inflow of pollutants into such facilities or land subject to restoration and not to cause danger to human health and safety' [GWA §2(6)], GWA specifies only facilities and land as the objects subject to the restoration to the original state, not groundwater, and it is unclear whether 'poor water quality' refers to water quality failing to meet the groundwater quality standards. Nor are there any concretely formulated procedures or methodologies

for contaminated groundwater risk assessment and groundwater remediation verification, and there is no clear legal framework for setting up measures for the disposal of contaminated soil. Against this background, we compared and analyzed the SECA and GWA, which are closely related to groundwater remediation, and sought strategic measures for strengthening nationwide groundwater quality management.

Main body

Comparison of the Soil Environment Conservation Act and the Groundwater Act

In Article 2(1) of the Soil Environment Conservation Act, soil contamination is defined as 'contamination of soil caused by business or other human activities, damaging the health and property of people or the environment,' and SECA Article 15 prescribes preventive measures against soil contamination. SECA §15-3 and Article 10 of the Enforcement Decree of the Soil Environment Conservation Act (SECA-ED) stipulate the soil remediation methods and standards. The relevant risk assessment is prescribed in SECA §15-5 and SECA-ED §19(3) and (4), and the verification of soil remediation in SECA §15-6 and SECA-ED §19(7). Detailed methods and procedures are presented separately in the Guidelines for Contaminated Soil Remediation Technologies (2007) and the Guidelines for Soil Contaminants' Risk Assessment (2015). Whereas SECA and SECA-ED provide all necessary definitions and relevant measures and standards, the Groundwater Act leaves some uncertainties. It only defines 'groundwater' as 'water filling or flowing through spaces between strata or rocks beneath the earth's surface' (GWA §2.1), and the definition of groundwater contamination can only be inferred from the 'facilities causing groundwater pollution' (GWA §16-2). Moreover, GWA does not provide for direct and concrete orders and methodologies regarding remediation of contaminated groundwater. Instead, the Enforcement Decree of the Groundwater Act (GWA-ED) prescribes 'purification of polluted groundwater' as one of the 'measures with respect to managers of facilities causing groundwater pollution' [GWA-ED §26-3(4)]. GWA §15(1)4 stipulates that in cases in which groundwater cannot be developed and used due to poor water quality, the related facilities and land must be restored to the original state after the pertinent permission or approval is obtained. According to the definition provided in GWA §2(6), 'restoration to the original state' means 'dismantlement of facilities or the proper reclamation of land in order to prevent the inflow of pollutants into such facilities or land subject to restoration and not to cause danger to human health and safety.' In other words, only facilities and land are specified as the objects subject to the restoration to the original state, not groundwater, and it is unclear whether 'poor water quality' refers to water quality failing to meet the groundwater quality standards. Furthermore, without any concrete procedures or methodologies for contaminated groundwater risk assessment and groundwater remediation verification, a clear legal framework for setting up measures for the disposal of contaminated soil is lacking. Table 1 outlines the results of comparison between SECA and GWA.

Strategic proposals

Necessity for new legislation for strengthening groundwater quality management. Unlike soil management, groundwater quantity and quality are managed separately under dual jurisdiction of the

Table 1. Comparison between the Soil Environment Conservation Act and Groundwater Act regarding the provisions for soil and water remediation.

Comparison item	Soil Environment Conservation Act (SECA)	Groundwater Act (GWA)
Definition of pollution	■ Soil contamination, contaminants, objects subject to remediation, etc. are defined (§2)	■ **Only 'groundwater' was defined** (§2) ■ No direct definition of groundwater pollution; meaning can be inferred from the definition of '**facilities that pollute groundwater**' (§16.2)
Preventive measures	■ Preventive measures against soil contamination are prescribed (§15)	■ Order to prevent pollution and take measures for facilities that pollute groundwater (§16.3) ■ Order to take necessary measures based on the result of water quality testing (§20.2; §8 of the management guidelines for items not meeting the groundwater quality standards)
Remediation	■ §15–3 (Purification of Contaminated Soil) prescribes remediation according to the purification standards and methods prescribed by Presidential Decree ■ **Remediation methods are specified in Article 10 of the Enforcement Decree (ED)**	■ **No direct and concrete orders and methodologies regarding remediation** of contaminated groundwater ■ GWA-ED §26-3(4) prescribes 'purification of polluted groundwater' as one of the 'measures with respect to managers of facilities causing groundwater pollution' ■ If groundwater cannot be developed and used due to **poor water quality**, the related facilities and land must be **restored to the original state** [GWA §15(1)4]
Risk assessment	■ Risk assessment items and procedures are prescribed in SECA §15-5 and SECA-ED §19 (3) and (4)	■ **Without guidelines set out by law**, Contamination Risk Assessment Guidance and assessment methods presented by international organizations (WHO, EPA, etc.) are used (§3 of the Rules governing the groundwater contamination reporting, Annex 1)
Remediation verification	■ Verification of soil remediation is laid down in SECA §15-6 and SECA-ED §19(7)	■ Mention of 'presentation of a verification plan' in the Groundwater Remediation Work Guidance (2013) without any concrete content

Ministry of Land, Infrastructure and Transport, and the Ministry of Environment, respectively. However, the GWA governs both the quantity (development and utilization) and quality (impact and conservation) of groundwater, with the former making up a much larger proportion. For this reason, the legal framework for water quality management is not sufficient for adequately dealing with the issues related to contamination and remediation in comparison with soil quality management.

Moreover, people tend to regard groundwater as a private asset rather than a public asset, and groundwater issues have revolved around its 'development and utilization' aspect, rather than its 'conservation' aspect. With a recent increase in groundwater consumption in the form of bottled water and increasingly widespread awareness about deep groundwater as safe drinking water, and subsequent increase in deep

groundwater source development, there are increasing concerns about groundwater contamination at the level of aquifers.

Soil and water contamination usually occurs more frequently in combination at the same site than separately due to contamination mechanisms. At a practical level, groundwater remediation is carried out much less frequently than soil remediation, and it is done only as part of soil remediation in most contamination sites. Consequently, we find hardly any cases in which groundwater remediation has been conducted independently of soil remediation. The groundwater remediation rate is considerably lower than the contaminated groundwater detection rate, primarily due to the absence of a clearly formulated legal framework for groundwater remediation, unlike soil remediation.

Given that early detection and adequate countermeasures have a much greater impact on groundwater contamination than on soil contamination, with much higher duration and expenses required for remediation once the critical time for response is passed, it is high time that the government prepared a groundwater quality conservation law as a clear and concrete legal framework to properly regulate groundwater contamination management.

Since groundwater quality management has required much higher expenses than groundwater quantity management, a systematic groundwater quality management and viable groundwater remediation market can be realized only with strong legislative support through such a groundwater quality conservation law. To this end, there is a need to raise nationwide awareness about the necessity of such a law and to raise necessary resources.

Strategies for preparing the legal framework for groundwater remediation based on the current Soil Environment Conservation Act.   In the Republic of Korea, groundwater remediation is generally regarded as belonging to soil remediation and is mostly carried out as a subsidiary project of a soil remediation project. The current Groundwater Act prescribes an order to prevent pollution and take measures for 'facilities that pollute groundwater,' and such facilities belong to the facilities subject to soil contamination management under the Soil Environment Conservation Act. Furthermore, soil remediation and groundwater remediation are managed by different public officials of the municipal and regional governments under the current laws, resulting in administrative problems such as failure to report cases of groundwater contamination detected during soil remediation to the responsible groundwater managers. Therefore, as a practical alternative to enacting a new law, expanding the legal framework for groundwater remediation by expanding the SECA and SECA-ED provisions applicable to groundwater remediation may be considered, such as facilities subject to soil contamination management, soil contamination inspection, order to prevent soil contamination, contaminated soil remediation, risk assessment, and verification of remediation, at the sites affected by both soil and water contamination. Additionally, one manager will have to be appointed to deal with both soil and groundwater quality management. However, such an alternative plan cannot be a fundamental solution to problems associated with groundwater quality management, especially because it cannot be applied to cases in which the site is affected only by groundwater contamination. In consideration of the problems posed by the dual jurisdiction between the Ministry of Environment and the Ministry of Land, Infrastructure and Transport, these measures will have to be used as an alternative plan pending the enactment of the 'Groundwater Quality Conservation Act' (a tentative title).

Flexibility-based strategies for groundwater remediation measures.   Two major stumbling blocks to the expansion and development of the groundwater remediation market are the insufficiency of the

legal framework and the financial burden of remediation costs to be incurred due to uniform application of remediation standards disregarding the purposes and circumstances of site use. In the Republic of Korea, the groundwater remediation standards are based on the domestic water standards, but it is crucial for sustainable groundwater quality management to implement flexible operation of the standards based on region, water body unit, and land use, taking account of the actual use characteristics and background concentration of the contaminated site. As the first step toward this goal, it is necessary to establish background concentration standards tailored to the country's situation by combining the results of the ongoing 'regional background concentration calculation study' as a separate project and the EU background concentration standards. Based on the background concentration standards thus established, a follow-up study can be conducted to prepare a flexibility-based groundwater remediation standard, and its results will then have to be included in the future groundwater remediation guidelines.

Conclusions

As a result of reviewing the domestic laws, regulations, and guidelines related to groundwater remediation, it was verified that there is an urgent need to establish a legal framework for groundwater remediation by enacting the 'Groundwater Quality Conservation Act' in addition to the current Groundwater Act, which focuses on groundwater development and utilization, as a fundamental solution to the problems related to groundwater quality management. However, as an alternative plan that can mitigate the resistance and burden that may be caused by the enactment of a new law, an expanded operation of the Soil Environment Conservation Act by adding groundwater-related content to the corresponding provisions may be considered. Alongside this alternative plan, a groundwater remediation scheme based on a flexible operation of standards, such as remediation standards for specific regions and different land uses taking account of the land-use characteristics and regional background concentrations of each contaminated site, might as well be introduced to strengthen sustainable groundwater quality management. Additionally, a follow-up study will have to be conducted to prepare the methods for raising resources necessary for the enactment of the Groundwater Quality Conservation Act, and its results will have to be included in the future groundwater remediation guidelines.

Since soil and water contamination are closely related at the level of contamination mechanism, soil and groundwater remediation is concurrently performed worldwide with rare exceptions. Considering that the laws and regulations governing soil contamination management are much more systematic and tenable than those governing groundwater contamination management in our country, it can serve as a good alternative to the enactment of a new law to benchmark the current soil contamination management laws, regulations, and guidelines, and to apply the results to groundwater quality management.

Acknowledgments

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