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Comparative Life Cycle Assessment of Soil Remediation Technologies: The Case of Janghang Songrim Forest

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Life Cycle Assessment (LCA), a systematic method of evaluating the environmental impacts of an entire process, will be employed in this study to compare three soil remediation methods. In this study, we apply LCA on the Janghang Songrim Forest in South Korea, a site primarily contaminated by arsenic from historical smelting operations. We examine three techniques, excavation & refill with soil washing, *in-situ* solidification/stabilization using iron oxide, and phytoremediation. The data used in the assessment is based on actual on-site practices implemented on the site around 2010. This study models and assesses the environmental trade-offs of each remediation scenario from a cradle-to-gate perspective, analyzing every stage from material extraction and transportation to remediation processes. The assessment is performed with Simapro software 9.6.0.1 using ReCiPe2016 impact assessment method, supported by field data, Ecoinvent database, literature, and site-specific information from Janghang Songrim Forest. The comparative analysis aims to guide future decisions on sustainable soil remediation by identifying low environmental impact, effective techniques for sites with similar contamination profiles. The goal of this study is to conduct a comparative life cycle assessment of the environmental impacts of widely used soil remediation methods especially focusing on greenhouse gas emissions, resource depletion, and effect on human health. In addition, this study seeks to identify environmental hotspots within each of the three technologies in order to determine the major contributing processes and propose targeted strategies for impact reduction.