

USING THE INTEGRATED PLANNING GUIDE FOR THE SELECTION AND DESIGN OF A MULTI-PROCESS STRATEGY FOR THE BIOREMEDIATION OF TOXAPHENE AND HEAVY METAL CONTAMINATED SOIL IN CHINANDEGA

Gasore Iraguha¹

Steven Simons¹

Henrik Haller¹

Anders Jonsson¹

Katia Montenegro²

*¹Mid Sweden University,
Sweden*

*²Biotechnology Laboratory, UNAN-Managua,
Nicaragua*

Abstract

The application of pesticides and inappropriate soil management during intensive cotton farming in Chinandega (Nicaragua) has left the soil with high residues of toxaphene and several other toxic metalloids and heavy metals from the overuse of chemical fertilizers. Remediation of soil is complex and most effective remediation approaches are relatively expensive and uses technologies that are energy-intensive.

The selection of appropriate and low-cost approaches for soil remediation requires a structured and systematic process to ensure reliable outcomes with low environmental impact, especially in developing countries where the cost and the energy content of remediation measures are a limitation. The Integrated Planning Guide which is a fusion of the concepts of Ecological Engineering and the Framework for Strategic Sustainable Development was used in the identification and design of some applicable and efficient approaches for the clean-up of soil in Chinandega.

This resulted in the design of a multi-process bioremediation strategy that meets the sustainability criteria of the Integrated Planning Guide and that has the potential to degrade toxaphene and remediate heavy metals and metalloids in the soil using *Jatropha curcas* L. for phytoremediation in combination with bioaugmentation, biochar as a soil amendment, and the use of biochar and alginate as carriers of toxaphene degrading inocula.

Keywords

Ecological Engineering, Framework for Strategic Sustainable Development, Toxaphene, Bioaugmentation, Phytoremediation, *Jatropha curcas* L., biochar, alginate