

Meta-Restore: Sustainable Rehabilitation of Mining-Affected Landscapes Using Native Tree Species as Potential Metallophytes in Tampakan, South Cotabato

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SDG Focus

KEY POINTS



Purpose: Develops science-based, plant-assisted solutions for rehabilitating mining-affected areas by identifying native metallophyte species and evaluating their potential for sustainable mine restoration.



Target Beneficiaries: Local communities in Tampakan, South Cotabato, environmental scientists, the mining industry, and government agencies involved.



Major Activities: Metallophyte identification and mapping, heavy metal soil analysis, field trials of native tree species, mycorrhizal inoculation, geospatial mapping, and long-term monitoring.



Key Partners: Sagittarius Mines, Inc. (SMI), DENR XII – MGB, and local communities.

Key Outcomes: The project identified over 20 native metallophyte species, produced soil metal concentration and geospatial maps, and demonstrated improved survival of mycorrhiza-inoculated native trees.

PROJECT DESCRIPTION

The Metallophytes Research is a long-term initiative led by the Environmental Science Department (ESD) in collaboration with Sagittarius Mines, Inc. (SMI) and DENR XII Mines and Geoscience Bureau to identify, evaluate, and apply plant-based solutions in heavy metal-contaminated environments, particularly in the proposed Tampakan Copper-Gold Project area in South Cotabato. The project aims to identify native metallophyte species, assess their phytoremediation potential, and explore their integration into sustainable rehabilitation practices for mining- impacted landscapes. Specific objectives include:

- 1) identifying and mapping potential metallophytes;
- 2) determining concentration and distribution of heavy metals in soils;
- 3) testing the survival and growth performance of metallophytes; and
- 4) enhancing growth via mycorrhizal inoculation.

The target areas are Barangays Pulabato and surrounding locations in Tampakan, South Cotabato. The primary stakeholders are the local communities, environmental scientists, and the mining sector.

This research spans several phases since 2017:

- Phase 1 (2017): Identification of Potential Metallophytes Along Proposed Copper-Gold Mining in Pulabato, Tampakan, South Cotabato.
- Phase 2 (2019): Potential Tree Metallophytes Along Proposed Copper Gold Mining Project
- Phase 3 (2022): Concentration and spatial distribution of heavy metals in topsoil surrounding the proposed Tampakan copper-gold project
- Phase 4 (Ongoing): 5-Year Trial Planting of Forest Tree Species Inoculated with Mycorrhiza in SMI Copper-Gold Environment Tampakan, South Cotabato

This project is one of the few in the region systematically integrating bioremediation into mining rehabilitation frameworks using native plant species, supporting sustainable and science-based restoration.

TANGIBLE OUTCOMES

The Metallophytes Research Project has created meaningful and measurable impacts on the University, the community, and the achievement of the United Nations Sustainable Development Goals (SDGs) through its innovative approach to sustainable mine rehabilitation. By identifying and documenting more than 20 native tree species with potential metallophyte characteristics, the project has established an important scientific resource for restoring mining-affected landscapes. The development of soil metal concentration and geospatial distribution maps has further strengthened evidence-based planning and environmental monitoring, enabling more effective rehabilitation strategies for degraded mine sites.

Impact to the University

At the University level, the project has significantly enhanced research productivity, academic excellence, and experiential learning. The publication of two peer-reviewed scientific papers has increased the institution's research visibility and contributed to the advancement of environmental science. More than 20 faculty members and student researchers actively participated in field surveys, laboratory analyses, geospatial mapping, and scientific writing, providing them with practical research experience and strengthening their technical, analytical, and problem-solving skills. The collaboration with Sagittarius Mines, Inc. (SMI) has also reinforced industry-academe partnerships, creating opportunities for future collaborative research and innovation.

Impact to the Community/ Society

For the community and society, the project provides practical, science-based solutions for the ecological restoration of mining-affected areas. The successful trial planting of mycorrhiza-inoculated native tree species demonstrated improved survival and growth,

supporting the use of bio-assisted phytoremediation as an environmentally sustainable rehabilitation strategy. These findings can guide mining companies, government agencies, and local communities in implementing more effective restoration programs while promoting biodiversity conservation and environmental stewardship.

The project also provides Sagittarius Mines, Inc. (SMI) with scientific evidence for rehabilitation planning, environmental monitoring, and post-mining land restoration. These research outputs help improve revegetation success, support compliance with environmental regulations, and strengthen the company's commitment to responsible and sustainable mining practices.

Impact to SDGs

The project also contributes directly to several SDGs, particularly SDG 9 (Industry, Innovation and Infrastructure) through research-driven rehabilitation technologies, SDG 13 (Climate Action) by promoting ecosystem recovery and long-term carbon sequestration, SDG 15 (Life on Land) by restoring degraded terrestrial ecosystems, and SDG 17 (Partnerships for the Goals) by strengthening collaboration among academia, industry, and other stakeholders.

SUSTAINABILITY PLAN

The Metallophytes Research Project will be sustained through the integration of research, instruction and extension in the academic curriculum and continued strong stakeholder partnerships. Future activities will expand the trial planting of selected native metallophyte species across larger areas within the proposed mining site while continuously monitoring tree survival, growth, soil quality, and ecosystem recovery. Faculty members, student researchers, local communities, and industry partners will participate in long-term monitoring to ensure continuous improvement of rehabilitation strategies.

The project will remain active through undergraduate and graduate research, faculty-led studies, institutional research funding, and

external grants. Future research will focus on the genetic profiling of promising metallophyte species and the enhancement of bio-assisted phytoremediation techniques to improve mine rehabilitation practices.

Collaboration with Sagittarius Mines, Inc. (SMI), the Department of Environment and Natural Resources (DENR), the Mines and Geosciences Bureau, and other research institutions will strengthen technical expertise, resource sharing, and funding opportunities. Community-based nurseries will also be developed to encourage local participation in producing native metallophyte seedlings for restoration activities.

To expand its impact, the project's species database, soil maps, and rehabilitation protocols will be integrated into the Environmental Science, Forestry, and Agroforestry programs of the University of Mindanao and shared with other institutions. With continued institutional support and multi-sector collaboration, the project can be replicated in other mining-affected areas in Mindanao, providing a scalable and replicable, science-based model for sustainable ecological rehabilitation.