Research Article

Social acceptability of the rehabilitation efforts conducted in an inactive mined-out area in Marinduque, Philippines

Katrine Mae B. Mante1,2,3*, Nina M. Cadiz2,3

1 Bohol Island State University-Calape Campus 6328, Bohol, Philippines
2 School of Environmental Science and Management, University of the Philippines Los Baños, Los Baños 4031, Laguna, Philippines
3 Institute of Biological Sciences, University of the Philippines Los Baños, Los Baños 4031, Laguna, Philippines

*corresponding author: katrinemae.mante@bisu.edu.ph

Abstract

The present study assessed the acceptability of the rehabilitation efforts conducted by the University of the Philippines Los Baños (UPLB) Bioremediation Team in an inactive mined-out area in Mogpog, Marinduque, Philippines from 2006 to 2016. A researcher-made semi-structured questionnaire was used to interview key informants, like members of the local government unit (LGU) of Mogpog, Marinduque, head of the Provincial of Environment and Natural Resources Office (PENRO), and selected residents of Barangay Ino and Capayang near the mining site. The selection of the respondents (n=112) was done through a stratified random probability sampling among residents ages 20 years old and above to determine their awareness and knowledge about the mined-out area before and after its rehabilitation. Interview with key informants revealed different functions towards the rehabilitation of the mined-out area. Results also showed that 59% of the respondents were aware of the rehabilitation efforts made on the site, and 98% of them strongly agreed on the presence and harmful effects of toxic chemicals in the area. They also strongly agreed that the rehabilitation efforts had a positive impact on the environment, biodiversity and the community nearby. Interventions implemented by the government and other agencies are likely to succeed with the help of the nearby community and therefore, the same community can also be the best judge to determine the acceptability of the interventions.

Keywords:
bioremediation
intervention
local community
mined-out area
social acceptability

Introduction

Recently in the Philippines, there is heightened pressure by the government among mining companies regarding safeguarding the environment. More have become sensitive to the damages and dangers that mining activities could bring. Thus, the rehabilitation of mining areas is becoming a priority.

Rehabilitation in the Philippines is based on the provisions provided by The Philippine Mining Act of 1995 and its forerunners. According to the Coordinating Committee for Geoscience Programme (CCOP) (2018), there is a public notion that the closure process, such as decommissioning and rehabilitation, comes after the mining operation. This, however, is incorrect since the environmental protection and enhancement program should be planned in every step of the pre- to post-mining operation together with the other pre-operational activities like acquiring necessary permits from the government, which will be part of every step of the mining operation. CCOP (2018) published a book that showcased the success
stories of mine rehabilitation and decommissioning programs from each member country - Indonesia, Japan, Korea, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Papua New Guinea and Thailand. In the Philippines, Rio Tuba Nickel Mining Corporation (RTNMC), the oldest and biggest nickel ore producer, was featured to have a successful mining rehabilitation. Its mine tailings surface facility has developed vegetation and turned into agricultural land where products like *pandan* (*Pandanus* sp.) and wild sugarcane (*Saccharum spontaneum*) are harvested as raw materials for souvenir products for tourists. The inactive mined-out area in Mogpog, Marinduque, Philippines, owned by Consolidated Mines Inc., is one of the mining sites included in the list of Tetra Tech (2001), an organization that assesses mining sites that threatens human and environmental health. It has been abandoned for more than two decades and by 2006, the *Jatropha* program of University of the Philippines Los Baños (UPLB) established a rehabilitation effort in the area. A paper by Aggangan et al. (2017) cited by Mante et al. (2019) listed the different remediation interventions utilized by the project. In addition, a satellite image of the study site shown in Figure 1 (2004) displays a bare amount of land. Another satellite image of the said area taken last 2016 (Figure 2) shows a change in vegetation.

![Figure 1. Historical satellite image of CMI, Mogpog, Marinduque dated November 24, 2004.](image1)

![Figure 2. Historical satellite image of CMI, Mogpog, Marinduque dated November 21, 2016.](image2)
Policies and interventions implemented by governments and other agencies are likely to progress with the help of the local community (Conrad and Hilchey, 2011). Therefore, the nearby community can be both an asset and a liability to the success of rehabilitation efforts and also the best judge to determine the changes happening in its periphery. Further, they tell whether a certain rehabilitation effort is acceptable or not (Shindler et al., 2002). Their opinion also plays a fundamental role in policy choices (Anderson et al., 2017), and the success of alternative government solutions to environmental problems are highly dependent on public acceptance (Dreyer et al., 2015 and Kallbekken et al., 2013 as cited by Huber et al., 2020). For decades that the inactive mined-out area has been abandoned, wherein a rehabilitation from 2006 to 2016 was conducted after that warrants assessment of institutions and community’s contribution to rehabilitation efforts.

Materials and Methods

The acceptability of the rehabilitation efforts conducted by the UPLB Bioremediation Team was assessed using two questionnaires. A researcher-made interview guide was used to interview the key informants of different institutions (Figure 3), namely: Barangays Capayang and Ino, Consolidated Mines Incorporated (CMI), Municipality of Mogpog, Provincial Environment and Natural Resources Office (PENRO), Mogpog Comprehensive National High School and the UPLB Bioremediation Team. Another researcher-made semi-structured questionnaire was used to interview the community.

Key informants include barangay chairpersons, municipal mayor, PENR Officer, school principal and lead researcher. Respondents from the community were from Barangay Ino and Capayang, Mogpog, Marinduque where the inactive mined-out area is situated and where the rehabilitation effort was conducted. Selection of respondents was done through stratified random probability sampling among 560 residents aging 20 years old and above to reflect their knowledge on the before and after the rehabilitation effort. A total of 112 respondents were interviewed. Results from key informants were documented and the answers of respondents from the community were tallied. Table 1 shows the composition of the respondents in terms of age, sex and educational attainment. A total of 74 females and 38 males were interviewed belonging to the following age groups: 20 – 29 (29 respondents), 30 – 39 (27 respondents), 40 – 49 (27 respondents), 50 – 59 (16 respondents) and 60 and older (14 respondents). Out of 112 respondents, 57 reached high school level, while only three were vocational course graduates.

Table 1. Composition of the respondents in terms of age, sex and educational attainment.

| Sex      | Age group | Educational Attainment         |
|----------|-----------|--------------------------------|
| Male     | 20 – 29   | Elementary Level               |
| Female   | 30 – 39   | High School Level              |
|          | 40 – 49   | College Level                  |
|          | 50 – 59   | Vocation Course Graduate       |
|          | 60 – older|                                 |

| Male     | 28        | 29 |
| Female   | 74        | 27 |
|          | 16        | 23 |
|          | 14        | 3  |

Respondents: 112
Results and Discussion

Interviews with key informants were conducted to describe the involvement and contribution of the institutions in the rehabilitation project. An interview with the mayor of Mopog revealed that the CMI mining area used to be a private property and was bought from the residents of the area before the start of their operation in the late 1970s. Until 2017, the owners were unable to settle their realty tax at the Municipal Treasurer’s Office. Furthermore, the interview indicated that CMI stopped its operation due to some internal management issues in the 1980s, which was confirmed by the CMI representative.

The Department of Environment and Natural Resources (DENR), the government agency that grants permits and regulates mining activities and their rehabilitation, would not prioritize and include private properties in their tree planting program. According to the Philippine Mining Act of 1995 and Presidential Decree 1586 of 1982, mining companies are responsible for rehabilitating the mining site as part of the decommissioning phase. However, the mining company had ended its operation in 1979; thus, it can no longer be held liable under this law.

While the province is under a moratorium on mining, the CMI allowed the previous owners of the land to use it for agriculture. However, farmers complained of the low harvest and unhealthy growth of plants, showing yellowing of leaves and stunted growth. In this regard, Local Government Unit (LGU) of Mopog, specifically CMI inactive mined-out site, became one of the study sites of the Bioremediation project of UPLB. Meanwhile, interviews revealed that the LGU-Mopog and BLGU-Capayang fully supported the rehabilitation project. LGU-Mopog provided the logistics and BLGU-Capayang helped in providing the manpower during the planting activity. BLGU-Capayang has also included a “no cutting of trees” policy in the rehabilitated area as part of their Barangay General Assembly. Although some of the narra trees (Pterocarpus indicus) were cut down for building purposes, and auri (Acacia auriculiformis) used for both building purposes and fuelwood were still observed during the site visit. Some parts of the rehabilitated area became dumping sites of domestic wastes. On the other hand, the BLGUs and LGU had not taken action in requiring CMI to rehabilitate the mined-out site.

The interview with the principal of MCNHS expressed that they have been educating their students on the importance of planting trees as one of their thrusts. They have been taking part in planting trees near their school buildings located just below the mined-out site. This supports the rehabilitation done by UPLB on top of the rock mined-out site, which was nearly inaccessible and would be dangerous for high school students to climb.

Results of the survey in the community showed the awareness of the respondents on the rehabilitation of the mined-out site (Table 2). About 59% of the respondents were aware of the rehabilitation efforts done in the mined-out site. It also showed that 98% of the respondents believe that there are harmful/toxic chemicals in the mined-out area and that majority (95%) believe that their presence affect the growth of plants present in the said area. Most of the respondents (98%) also agree that harmful/toxic chemicals negatively affect the health of humans.

Most (92%) respondents mentioned that there was an increase in the number of plant species (Table 3) other than ferns and talahib (Saccharum spontaneum) initially present. Mante et al. (2019) observed significantly higher mean species richness under rehabilitated area as compared with the unrehabilitated area. A listing of plant species in the course of rehabilitation was made which showed plants that were used in the rehabilitation (i.e. Cassia spectabilis, Pterocarpus indicus, Jatropha curcas, Bauhinia purpurea), plants that were found in the area before rehabilitation (e.g. Tremna orientalis, Saccharum spontaneum, Nephronephros sp., Davallia solida) (Cadiz et al., 2012; Aggangan et al., 2017) and after the rehabilitation (e.g. Passiflora sp., Citorea ternatea, Centrosema sp., Merremia tridentate, Melothria pendula, Psidium guajava, Leucaena leucocephala, Chromolaena odorata, Breyenia vitis-idea, Morinda spp.). The latter group of plants is considered the recruited plant species which may have been brought by wind or other vectors such as animals.

Table 2. Awareness of respondents on the rehabilitation effort done in the inactive mined-out area.

| QUESTIONS | Brgy Capayang and Ino |
|-----------|-----------------------|
|           | Yes | No |
| Are you aware that UPLB conducted a rehabilitation effort in the abandoned mined-out area? | 59 | 41 |
| Are you aware that there are harmful/toxic chemicals in the abandoned mined-out area? | 98 | 2 |
| Do these harmful/toxic chemicals affect the growth of plants in the abandoned mine out area? | 95 | 5 |
| Do you think that these harmful/toxic chemicals negatively affect the health of humans? | 98 | 2 |
Table 3. Awareness of the respondents on the changes brought by the rehabilitation efforts.

| QUESTIONS                                                                 | AWARENESS (%) |
|---------------------------------------------------------------------------|----------------|
|                                                                           | Brgy Capayang and Ino |
| Have you observed changes in the number and composition of plants?        | Yes: 92, No: 8    |
| Have you observed changes in the number and composition of animals?       | Yes: 86, No: 14   |

In addition, more trees like auri (*A. auriculiformis*) abounded in the area. About 86% of the respondents noted that some birds like kulokulo (*Gallicolumba platenae*), maya (*Passer montanus*), tagak (*Egretta spp.*), batobato (*Streptopelia spp.*), paypago (*Pycnonotus goiavier*), and tikling (*Gallirallus spp.*) frequented the area presumably in quest for food or resting place. Tomasen et al. (2005) stated that bird droppings could positively impact the soil by providing nutrients such as nitrogen. This creates positive feedback to the rehabilitation efforts. In addition to the birds, they also observed the presence of fireflies, spiders, ants and bees, in the rehabilitated area. The community’s awareness of the institution’s obligations in rehabilitating the mined-out site is presented in Table 4. As to whose obligation should the rehabilitation of the mined-out area be, 83% of the respondents indicated that it should be the mining company (i.e. CMI). The results also showed that 88% and 86% of the respondents believed that government agencies and LGU-Mogpog, respectively, can influence CMI to rehabilitate the area.

Table 4. Awareness of the respondents of the obligations of institutions in rehabilitating the mined-out area.

| QUESTIONS                                                                 | AWARENESS (%) |
|---------------------------------------------------------------------------|----------------|
|                                                                           | Brgy Capayang and Ino |
| Is it the obligation of CMI to rehabilitate the mined-out site?            | Yes: 83, No: 17  |
| Can DENR obligate the CMI to rehabilitate the area?                       | Yes: 88, No: 12  |
| Can LGU-Mogpog oblige CMI to rehabilitate the area?                       | Yes: 86, No: 14  |

With regards to the need for expansion of the rehabilitation project, 91% of the respondents affirmed its need (Table 5). In addition, 89% of the respondents believed that the rehabilitation efforts had benefited the community and the animals in the area; thus, majority of the respondents were supportive of expanding the rehabilitation project. The respondents could support the started initiative in terms of planting more trees, joining activities organized by the barangay such as clean up drive, and not cutting the trees that have been planted. In addition, involvement of the youth, information drive, as well as follow-up studies in support of rehabilitation efforts were suggested by the respondents could do. High awareness of the community on rehabilitation and its positive effects can be a basis for the success of the rehabilitation. Furthermore, positive citizen acceptance is expected to bring a higher level of policy support (Huber et al., 2020); therefore, it can be a central point for management strategies. The impacts of the rehabilitation to the community, therefore, could also be a basis to duplicate the rehabilitation project to other sites within the mined-out area of Mogpog, Marinduque and encourage governments to enter into agreements with the mining companies. The support from the community towards rehabilitation efforts can hasten the restoration of the whole inactive mined-out sites in Mogpog, Marinduque.

Table 5. Awareness of the respondents on the need for expansion of rehabilitation project.

| QUESTIONS                                                                 | AWARENESS (%) |
|---------------------------------------------------------------------------|----------------|
|                                                                           | Brgy Capayang and Ino |
| Is there a need to expand the rehabilitation effort?                      | Yes: 91, No: 9   |
| Is/Are there positive effect/s or benefits of the rehabilitation effort?  | Yes: 89, No: 11  |
| Are you willing to help if rehabilitation will be expanded?              | Yes: 98, No: 2   |

**Conclusion**

Rehabilitation of mined-out areas was very much supported by the community in Mogpog, Marinduque with a very high awareness of its negative impact in human health and environment. Respondents agree that due to the regrowth of plants where rehabilitation initiative was carried out, plants and animal diversity increased. Because of the positive effects of rehabilitation, the community is empowered to do
more and support similar initiatives. The information on the level of awareness and participation of the community and the role of institutions for improved implementation of rehabilitation projects in Mopog, Marinduque, Philippines, emphasizes the importance of collaborative involvement and contribution of institutions and community the success of rehabilitation efforts of mined-out sites.

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