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Master's Thesis

Evaluation of Abandoned Mine Lands Rehabilitation: The Case of Bagacay Mine, Western Samar Philippines

(放棄鉱山の地域再生評価：フィリピン、ウェスタンサマール州バガカイ鉱山を事例に)

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Abstract

Over the last thirty years, several large-scale mines have shut down their operations in the Philippines. These mines were abandoned and not rehabilitated accordingly due to the absence of legislations for closed mines before the institutionalization of the Mining Act of 1995. And since no more owners can be held responsible, the burden of clean-up was left to the government following the Executive Order No. 270 of 2004 which requires the remediation and rehabilitation of abandoned mines. Abandoned mine lands (AMLs), when left untreated pose numerous risks such as environmental degradation, public health and safety, and socio-economic drawbacks. In the Philippines, only one AML is undergoing a full rehabilitation process – the closed copper and pyrite mine in Hinabangan, Bagacay, Western Samar. The purpose of the study was to evaluate the rehabilitation measures in terms of: 1) the objectives and parameters of the project itself; and 2) the perception of local residents regarding the rehabilitation efforts through both qualitative and quantitative research methods. Results showed that AML rehabilitation is still a relatively new concept for developing countries like the Philippines. The country has a long way to go in terms of establishing a strong governance that is willing to take accountability of AMLs. In the case of Bagacay, the rehabilitation effort is still in its early stages and needs further improvement.

Keywords: Bagacay, Philippines, Abandoned Mine Lands, Rehabilitation

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

AMD - Acid mine drainage

AMLs - Abandoned Mine Lands

APT - Asset Privatization Trust

BMB - Biodiversity Management Bureau

CIDG - Criminal Investigation and Detection Group

DENR - Department of Environment and Natural Resources

DOF - Department of Finance

DOT - Department of Tourism

EHS - Environment, Health and Safety

EMB - Environmental Management Bureau

EO - Executive Order

ERDB - Ecosystems Research and Development Bureau

FGD -Focus Group Discussion

IEC - Information and Education Campaign

KII - Key Informant Interview

LGU - Local Government Unit

MGB - Mines and Geosciences Bureau

MGB-CO - Mines and Geosciences Bureau-Central Office

MGB-MESD - Mines and Geosciences Bureau, Mining Environment and Safety Division

MGB-MGSD - Mines and Geosciences Bureau-Marine Geological Survey Division

MGB-VIII - Mines and Geosciences Bureau-Region VIII

MMIC - Marinduque Mine Industrial Corporation

NGOs - Non-government Organizations

NIPAS - National Integrated Protected Areas System

NPS-ENRMP - National Program Support for the Environment and Natural Resources Management Project

PASu - Protected Area Superintendent

PMO - Privatization and Management Office

PNB - Philippine National Bank

POs - People's Organizations

PPC - Philippine Pyrite Corporation

RA - Republic Act

RCP - Responsible Care Program

SINP - Samar Island Natural Park

SMEs - Subject Matter Experts

1. INTRODUCTION

1.1 Background

"Abandoned mine lands (AMLs) are [. . .] referred to as 'areas or sites of former mining activity for which no single individual, company, or organization can be held responsible', and such sites are also known as 'derelict' or 'orphan' mines (Venkateswarlu et al., 2016)". Numerous large-scale mines have shut down their operations in the Philippines over the last thirty years. However, these AMLs were not rehabilitated accordingly (Ilagan, 2009) since there were no legislations in place for closed mines before the Philippine Mining Act of 1995.

Environmental degradation is a major problem among AMLs. When environmental issues arise, the health and safety of communities nearby are also affected (Dayang, 2017). If AMLs are kept uncleaned, it degrades the quality of agricultural lands which is the major source of income in rural communities. Subsequently, this gives birth to several social problems. (Cobarzan, 2008). Therefore, like the pollution control measures, the social component of AML rehabilitation needs equal attention. According to Executive Order No. 270 of 2004 entitled National Policy Agenda on Revitalizing Mining in the Philippines, "remediation and rehabilitation of abandoned mines shall be accorded top priority to address the negative impacts of past mining projects". In the Philippines, only one AML is undergoing a full rehabilitation process – the closed copper and pyrite mine in Hinabangan, Bagacay, Western Samar in the Visayan islands. This study looked at different cases of rehabilitation of mined-out sites both in the Philippines and other countries in order to determine what a full rehabilitation is. Based on literature, the components of a full rehabilitation were categorized into four: environmental, public health, public safety, and socio-economic. This will be discussed fully in **Chapter 2.**

In a study conducted by the Mining Environment and Safety Division of the Mines and Geosciences Bureau (MGB-MESD), large amounts of heavy metals such as copper, lead, mercury, zinc, and iron were found in the abandoned mine as cited in Dayang (2017). Three distinct adverse impacts were identified through the assessment: (1) acid

mine drainage (AMD) caused by the heavy metals, (2) chemically-contaminated soil erosion into the Guila-Guila creek which discharges into the Taft River, (3) and visual/aesthetic impacts (ERDB and DENR, 2016). The continuous sediment loading caused siltation of the Taft River (World Bank and DENR, 2006).

In the 2017 MGB list of AMLs, Bagacay Mine ranked first priority. The list includes 14 other AMLs that need rehabilitation based on their projected risks. Several studies, researches, and investigations were done in Bagacay from 1999 to early 2012. In 2009, Ecosystems Research and Development Bureau (ERDB), in coordination with the MGB of the Department of Environment and Natural Resources (DENR), started its research on phytoremediation ─ a method that involved reforestation towards the rehabilitation of the mined-out area (MGB and ERDB, 2014).

1.2 Problem Statement

The mining sector undeniably contributes to the economic growth of several countries, but not without having to deal with controversies regarding adverse environmental issues. In the Philippines, the industry has a considerable contribution to the gross regional domestic product of regions that heavily rely on mining (Miraflor, 2017). Hence, its significance in these areas is irrefutable.

On the other hand, the cessation of mining operations poses numerous challenges, particularly those that shut down before The Mining Act of 1995 was institutionalized. Due to the lack of regulatory provisions at the end of the mine life cycle, none of the AMLs were rehabilitated. In effect, environmental pollution in the form of heavy metal contamination and acid mine drainage, among others, were experienced by the adjacent communities (Venkateswarlu et al., 2016). It is crucial to evaluate the remediation of the abandoned mines to prevent further environmental degradation and health problems caused by toxic wastes. It is also essential to examine whether there are sufficient efforts to restore the biodiversity that originally thrived in mined areas.

1.2.1 Research Gaps

A key gap in literature is that there is very little known about the effects of abandoned mine lands. This leads to the question of why there is a need to rehabilitate them. There are no available studies on the public perception of the rehabilitation efforts in mined-out sites. This study aims to identify the gaps between the public perception of the rehabilitation efforts and the actual rehabilitation process in the former Bagacay Mine. The research would help the government to better assess the rehabilitation outcome and address arising issues based on the results of the survey. This study would serve as a baseline for formulating a concrete full rehabilitation plan for AMLs and evaluating the rehabilitation process in terms of environmental remediation criteria, social aspects, and economic benefits.

1.2.2 Research Assumptions

Rehabilitation after mining operations should be mandatory because AMLs, when left untreated, pose risks to the environment and the communities nearby. However, the Philippine government has no concrete definition of rehabilitation, let alone a full rehabilitation. Based on literature, a full rehabilitation involves the remediation of all components (e.g., environment, public health, public safety, and socio-economic). In reality, the Bagacay Mine rehabilitation program does not deal with all of these aspects, even though the government stated that they are administering full rehabilitation in the area.

That being said, the research rests on three assumptions. The first assumption is that full rehabilitation of all components must be applied to the Bagacay Mine rehabilitation program in order to ensure environmental safety and community welfare. Secondly, it is assumed that the future land use plan for the former Bagacay Mine does not consider the re-opening of the mine since it is within the borders of SINP. This is following the premise that extractive activities are not allowed in protected areas. Lastly, the local government, organizations, and community are assumed to be involved in the rehabilitation and decision-making process.

1.2.3 Research Questions

To be able to meet the research purpose, the following questions were asked:

1. What are the criteria for declaring a mine site abandoned and what were the rehabilitation methods used and the reason for choosing them?
2. What are the criteria for successful rehabilitation?
3. How do the local residents perceive the rehabilitation efforts in Bagacay?
4. What is the future land use plan for Bagacay Mine and who are involved in the decision-making process?

1.3 Purpose of the Study

Generally, this study aims to evaluate the rehabilitation measures in the former Bagacay Mine. Specifically, it intends to evaluate the rehabilitation measures in terms of: 1) the objectives and parameters of the project itself; and 2) the perception of local residents regarding the rehabilitation efforts. Furthermore, it aims to explore possible options for the social component of the rehabilitation since there was no concrete plan about it in the project objective. It also intends to identify jurisdictional loopholes regarding AMLs and propose possible amendments.

1.4 Significance of the Study

Samar Island is among the 200 eco-regions in the world due to its high rate of endemism and biodiversity – 947 species of vascular plants, 34 amphibian species, 65 reptilian species, 147 avian species, and 47 mammalian species. These reasons make it a sensitive area for mining (DENR-Environmental Management Bureau, year not specified). Because of this, the Samar Island Natural Park (SINP) was established in 2003 with the goal of conserving the remaining biodiversity resources and alleviating poverty among local communities in Samar Island (DENR-PAWB, 2004).

The findings of this research will benefit the communities affected by the pollution from nearby AMLs and will also be useful to the society by determining if there are

efforts exerted towards biodiversity restoration. The study will help to provide basis for evaluating rehabilitation practices which may be applied to the rest of the abandoned mine sites in the Philippines by accentuating notable accomplishments and challenges being faced by the current AML rehabilitation program.

1.5 Scope and Delimitations

The study scope included the rehabilitated mined-out site in Bagacay, Western Samar and adjacent communities affected by the mine tailings as a case study. The site was chosen since it is the only AML that is undergoing a full rehabilitation. The study was delimited on the evaluation of the rehabilitation in terms of environmental remediation criteria, social aspects, and economic benefits based on the inputs from government officials, local community members, and stakeholders. Various literatures such as official reports from government agencies and journal articles were also reviewed. The study also identified the remediation methodologies and techniques that may be replicated for the rest of abandoned mine sites in the Philippines.

2. LITERATURE REVIEW

2.1 Definitions of rehabilitation and related terminologies

Often, the term "rehabilitation" is interchangeably used with "reclamation", "restoration", and "remediation". However, rehabilitation is skewed towards managerial definition by measuring costs and benefits of environmental quality maintenance (Haigh, 2007 as cited in Lima et al., 2016), while reclamation is a more ecological one wherein the end goal is full ecosystem recovery. This is aligned with the definition of reclamation by Sheoran et al. (2010) wherein the productivity and biological function of highly degraded lands are targeted. Although here, the end goal is not a full ecosystem recovery. On the other hand, the goal of remediation is a contaminant-free site (Haigh, 2007 as cited in Lima et al., 2016), while restoration aims for the replication of the original flora and fauna of an ecosystem (Wali, 1996; Powter et al., 2012, as cited in Lima et al., 2016).

For the purpose of this study, the term "rehabilitation" will be used throughout the course of discussion to prevent confusion. And due to the lack of substantial definition of the term in the context of the MGB, the description based on Section 47 of the Presidential Decree 705 or Revised Forestry Code of the Philippines will be used: "Surface-mined areas shall be restored to as near its former natural configuration or as approved by the Director prior to its abandonment by the mining concern." Similarly, Section 71 of the Mining Act of 1995 pertaining to contemporary mined-out sites states that excavated, mined-out areas shall be "technically and biologically rehabilitated to the condition of environmental safety, as may be provided in the implementing rules and regulations of the Act." There is also a reference to social rehabilitation of affected areas and communities required from the mining companies which can be applied in AML rehabilitation.

2.2 Rehabilitation of mined-out sites in other countries

Various literature regarding rehabilitation of mined-out sites were reviewed. This section is comprised of a mix of cases of AML and non-AML rehabilitation from other

countries. They were selected to determine the specific rehabilitation components involved in each program regardless of the mined site being abandoned or not. The main difference between the two case types is that AML rehabilitation is funded by the government while non-AML rehabilitation is the responsibility of the existing mine owner.

For this study, rehabilitation components were classified into four categories based on literature review: environmental, public health, public safety, and socio-economic. Environmental component refers to the measures that deal with environmental degradation (e.g., reforestation or revegetation). Public health component consists of contamination control procedures, while public safety involves infrastructures that reduce physical hazards such as anti-erosion measures. Socio-economic component includes the future productive use of the rehabilitated site that will be useful to the community, as well as public involvement during the rehabilitation period. Although there were four major components identified, not all case studies deal with all aspects of rehabilitation. Some of them exclusively deal with the environmental constituent, while others have a couple of components in their programs.

Table 1 summarizes the components involved in each rehabilitation case. Components marked with "x" does not necessarily mean that they are not included in the rehabilitation at all. In many cases, for example, rehabilitation of the environmental component such as revegetation leads to the stability of land slopes. Hence, in a way, the public safety aspect was also addressed. The components identified in the table were the highlights of each rehabilitation case.

Table 1. Rehabilitation components involved in the rehabilitation of mined-out sites in foreign case studies.

Case study	Rehabilitation Component			
	Environmental	**Public Health**	**Public Safety**	**Socio-economic**
Israel	conversion into open spaces	x	landslide and erosion control measures	turning AMLs into development projects
Mary Kathleen uranium mine, Northern Australia	revegetation with native species	elimination of radiation hazards	elimination of physical risks	grazing as final land use
Jarrah forest, Western Australia	restoration of native plant species	x	x	x
New South Wales, Australia	investigation of various factors like climate, geology, landform, and soil substrates; evaluation of ecosystem services	x	x	transformation of Ballambi West underground mine into a golf course; conversion of Denehhurst Ltd's former Woodlawn mine into a dump
Germany	allowing the reconstruction of natural landscape through time	x	x	shifting ecological land-use
Canada	utilization of organic waste for the remediation of mine tailings	x	x	production of profit-yielding bioenergy feedstock from organic waste
Japan (Matsuo Mine, Iwate)	construction of drainage treatment plant	pollution control measures	x	x
Japan (Kamioka Mine, Gifu)	construction of barricades to prevent the drainage of polluted water into rivers	x	separation of clean and polluted water; prevention of leaks by repairing old equipment;	allowing local residents and a scientific expert to inspect the contaminated site; establishing an environmental auditing system; transparency through consultations with the victims' organizations

- In Israel, the Mining Regulations (Quarries Rehabilitation Fund) of 1978 govern the rehabilitation of abandoned quarries. Rehabilitation measures such as landslide and erosion control, as well as the future land use plan should be ensured. The designation of the future land use of abandoned quarries must follow the Israeli Comprehensive National Outline Plan for Planning Building and Conservation (NOP 35). The quarries can be rehabilitated into two general types: developmental areas or open spaces. Development projects can be in the form of industrial plants, residential buildings, cemeteries, or infrastructure, while open spaces can be nature reserves, forests, lakes, and recreational parks. As examples, Nachshonim quarry was partially reclaimed as an industrial plant; Haemek abandoned quarry was rehabilitated as a road and bridge; Neve-Yam abandoned quarry as an irrigation reservoir; and Carmiel abandoned quarry as a public park (Milgrom, 2008).

- The rehabilitation of Mary Kathleen uranium mine in Queensland, Northern Australia was implemented in 1982 in congruity with the Code of Practice for the management of radioactive waste. Aside from revegetating the site to combat erosion and eliminating radiation and physical hazards towards public health and safety, a final land use plan was formulated. Despite these measures, they are still considered not enough against the expectations of the present-day community. This is because the rehabilitation project was unable to meet "modern aesthetic expectations" since exotic flora were still present and not all mining infrastructures were removed from the site (Waggitt and Zapantis, 2000).

- In contrast with the rehabilitation cases stated above, the general public near the mining site of Alcoa in Western Australia preferred the restoration of native jarrah (eucalyptus) forest over conversion of mined-out areas into recreational facilities (Burton et al., 2012 as cited in Limpitlaw and Briel, 2014). Restoration initiatives after bauxite mining was documented by Koch (2007). Mining activities in the jarrah forest affect 300-400 plant species. Considering that the Southwest of Western Australia is a biodiversity hotspot, restoration is a priority. Alcoa, which has the world's largest bauxite mining portfolio,

employed various restoration methods such as direct transfer of fresh topsoil, addition of native seeds, and heat or smoke treatment to increase seed germinability. According to the article, Alcoa's target to establish the same number of native plant species per 80 square meters in restored areas as the natural forest has been achieved. Their next objective would be increasing the density of under-represented species (fire resprouter species) in the restored mining site.

- As stated by Zillig, Keenan, and Roberts (2015), rehabilitation measures of mined-out sites in New South Wales, Australia are devised after thorough investigation of various factors such as climate, geology, landform, and soil substrates. Ecosystem services were evaluated before determining the future landscape of the area. Governments decide whether to make a natural or novel ecosystem out of it. Successful rehabilitation can be gauged by faunal recolonization since it is a vital part of the ecosystem which is responsible for the fertilization of flora. As an example, near threatened spotted-tailed quolls were observed returning to the rehabilitated Mt Owen Mine near Singleton (Coalface Magazine, 2014; The IUCN Red List of Threatened, 2014 as cited in Zillig, Keenan, and Roberts, 2015). There were also rehabilitation cases with a "higher social value" such as the transformation of Ballambi West underground mine into a golf course and the conversion of Denehhurst Ltd's former Woodlawn mine into a dump wherein the methane gas produced by the waste is collected for electricity generation.

- In Germany, various rehabilitation methods were considered. One of these was the "least impact" where the mined site which is considered beyond repair is retrenched to give way for a natural landscape to develop through time. Another method was the "conventional practice" which manages the biotic and abiotic factors to reconstruct a natural landscape or "a land-use value comparable to the undisturbed landscape". If restoring the original ecosystem is impossible, the "shifting ecological function" technique is employed. This means that a "novel" ecosystem (e.g. agricultural land-use) is built in the mined-out land (Zillig, Keenan, and Roberts, 2015).

- A presentation by Zinck (2013) describes the four interconnected pillars of the Green Mining Initiative of Canada: footprint reduction, waste management, ecosystem management, and mine closure and rehabilitation. Organic waste is being utilized for the remediation of mine tailings. At the same time, it produces bioenergy feedstock. Three demonstration sites in Ontario: Sudbury (Vale), Onaping (Xstrata), Timmins (Goldcorp), have shown that 10 ton/ha (dry weight) of biomass, which is approximately 5 million liters of biodiesel (from canola) from half tailings area, can be produced annually. This yields a profit of roughly USD 900/ha.

- In Japan, the abandoned iron and sulfur mine in Matsuo which operated from 1914 to 1971 has turned into a ghost town. The main problem is the acidity of both the soil and the wastewater which affects the Kitami River and Pacific coast of Iwate prefecture. In order to combat these environmental issues, the government designed measures for pollution prevention: (1) construction works against pollution sources and (2) construction of drainage treatment plant (Umita, 1996). The Kamioka Mine in Gifu prefecture was the culprit for *itai-itai* disease due to cadmium poisoning via ingestion of polluted rice. Due to this incident, the Mitsui Mining and Smelting Co. allowed the local residents and a scientific expert to inspect the site for nearly 40 years. As a result, there had been a reduction to $1/15^{th}$ of the quantity of cadmium drainage. Rehabilitation measures included separation of clean and polluted water, prevention of leaks by repairing old equipment, construction of barricades to prevent the drainage of polluted water into rivers, establishing an environmental auditing system, and ensuring transparency through consultations with the victims' organizations. Later on, the company has been labeled by the society as "one that takes the environment seriously" (Yoshida, 2012).

Of these rehabilitation cases, those that have a beneficial after-use are the most ideal. For example, the use of organic waste in the rehabilitation of mined-out site in Canada produces bioenergy feedstock which contributes to the annual revenue. In the same manner, the conversion of a former Woodlawn mine in New South Wales, Australia into a waste dump generates methane gas for the production of electricity. These post-

closure land utilizations provide value-adding services compared to their original pre-mining use. These sites contribute to the national economic development since the land use changes generate revenues for the country. As stated by Jay and Handley (2001), "One of the indicators chosen for assessing progress towards sustainable development is the percentage of rehabilitated abandoned quarries for beneficial after-use (Milgrom, 2008)."

2.3 Rehabilitation of mined-out sites in the Philippines

Rehabilitation cases in the Philippines were also examined and components were determined for each case study as in **Section 2.2**. The succeeding cases are from the rehabilitation initiatives of private mining companies following the Mining Act of 1995. Mining companies must have their own rehabilitation programs as stipulated in the Act. Program components are also usually part of their corporate social responsibility (CSR) scheme. Most of the cases focus on the rehabilitation of environmental component, but there are cases that deal with other aspects such as socio-economic.

- Philex Mining Corporation has rehabilitated its mine tailings pond in Bulawan, Negros Occidental. The site, which is a former gold mine that ceased operation in 2002, has become a sanctuary for wild ducks (Juarez, 2012).

- In Benguet, the former tailings pond no. 1 (also by Philex Mining) has been rehabilitated as a bamboo forest. Another mining company, Nickel Asia, created an annual "progressive rehabilitation of mined-out areas" which includes ground re-contouring, topsoil provision, and using native species that are grown in nurseries for revegetation (The Standard, 2014).

- In Bataraza, Palawan, Coral Bay Nickel Corp. (CBNC) and Rio Tuba Nickel Mining Corp. (RTNMC), affiliates of Nickel Asia Corporation, have successfully rehabilitated their mined-out sites as part of their Social Development Management Program (SDMP) and corporate social responsibility projects. Based on the company report, they started the

rehabilitation by planting grass in the area to introduce organic matter to the soil. To date, they have already planted high-value crops, fruits, rice, herbal plants, and vegetables aside from native tree species. This provides employment opportunities to the community through seedling production and reforestation. Because of its best practices, the company have received multiple awards both in the national and international levels (Mayuga, 2016).

The Philippine government agencies also exerted efforts on rehabilitation of AMLs. For instance, the National Mapping and Resource Information Authority (NAMRIA) supports the National Greening Program (NGP) of the DENR by tree planting activities in inactive and abandoned mine sites (Taguba, 2016). There are also researches conducted by the National Research Council of the Philippines (NRCP) of the Department of Science and Technology (DOST) regarding the use of microbes in bioremediation of AMLs in Marinduque. The process uses native plants and their associated microbes of fungi and bacteria for the restoration and cleaning of the environment (Racasa, 2017).

2.4 Stakeholder involvement in AML rehabilitation

Stakeholder involvement in the rehabilitation of abandoned mine lands is important not only during the program implementation but most importantly at its completion. Stakeholders must include not only the concerned government agencies, private sectors and experts, but the community as well. It has been proven that local knowledge plays a significant role in the exchange of expertise not only in mine rehabilitation, but in elucidating environmental issues in general. For this study, several cases were reviewed regarding the importance of stakeholder involvement in the rehabilitation of AMLs.

Developing countries can learn from the examples of successful abandoned mine rehabilitation from developed countries such as Canada, Australia, and United States, among others.[1] This is not to compare the financial capacity of developing countries to that of developed nations in terms of carrying out a strong AML rehabilitation program

[1] These case studies might not be representative of the global scenario on AML rehabilitation but were selected due to their successful rehabilitation programs.

since the latter have better source of funding compared to the former. Instead, the focus can be shifted to the common denominator that these countries have in order to rehabilitate their AMLs successfully ─ and that is an expansive stakeholder engagement. The following describes how stakeholder engagement is an indispensable component which contributes to the success of a rehabilitation program:

- In Canada, the National Orphaned/Abandoned Mines Advisory Committee was created in 2002 which is composed of federal, provincial, and territorial government representatives, the Canadian mining industry, environmental NGOs, and Aboriginal peoples and their communities. The Advisory Committee is responsible for the inventory of information, encouraging community involvement, tackling legislative and institutional barriers to collaboration, working on funding approaches, and jurisdictional legislative review. The most comprehensive multi-stakeholder partnership program is that of the Province of Quebec wherein collaborations were forged between ministries and mining companies, the forest industry, and native peoples. The importance of including Aboriginal people as stakeholders is recognized by the government. In fact, partnership agreements with the Cree and the Inuit have been established (Brehaut, 2008).

- In Northern Australia where there is an abundance of uranium deposits, numerous uranium mines were abandoned in the 1960s during the lack of proper regulations in place regarding mine rehabilitation. Because of this, the government funded the rehabilitation programs for the AMLs (Waggitt and Zapantis, 2000). A universal factor in these programs is that the determinant of the success of the rehabilitation program is not only reliant on the government agencies executing the project, but also on the assessment of independent experts and the demands of the community. For instance, the South Alligator Valley uranium mines were initially rehabilitated in 1990 with hazard and radiation exposure reduction as the main objectives. The rehabilitation was completed after two years. However, due to the rise of public expectations regarding AML rehabilitation, additional rehabilitation measures were implemented in 2001. This time, the major objective shifted from just reducing

the physical hazards to revegetating the site which was incited to blend with the natural landscape of the countryside on top of not requiring a specialized maintenance in the future.

- Another case, still in Northern Australia is the rehabilitation of Rum Jungle Creek South mine in the 1990s. The final land use of the rehabilitated site was to be converted into a recreational lake and picnic area where the public are not restricted. The rehabilitation at the Nabarlek uranium mine in the Northern Territory was assessed by a third-party expert in 1999. But the assessment did not end there and was subject to approval of the stakeholders (Waggitt and Zapantis, 2000).

- In the United States, the Bureau of Land Management Abandoned Mine Land Program was established in cooperation with other government and non-government organizations to clean up abandoned and orphaned hard rock mine sites in the Western United States. For example, the Animas River Project in Colorado which shelters a watershed area that has roughly 1500 former mining sites, has engaged five citizen groups as partners and 10 private entities which include three small mining companies. More than USD35 million for direct remediation activities and USD3 million worth of in-kind services were successfully raised by the project. In the State of Nevada, the Ray Camp mining district had 63 orphan mines. To aid in the rehabilitation of these mines, member companies of Nevada Mining Association extended their assistance to the project by means of providing a bulldozer via a loan from an equipment dealer. The bulldozer was transported to the site through the help of a trucking company and an operator from a mining company (Brehaut, 2008).

3. METHODOLOGY

The study employed questionnaire surveys, focus group discussions (FGDs), and key informant interviews (KIIs). The questionnaire survey adopted basic descriptive statistics in analyzing and interpreting the public perception on the rehabilitation of the former Bagacay Mine in Western Samar. KIIs and FGDs were conducted in order to interpret and triangulate the results of the questionnaire survey.

3.1 Study site and target group

The study involved the residents of Brgy.[2] Bagacay and other *barangays* (communities) along Taft River, down the watershed. It investigated the perception of residents in Brgy. Bagacay and nearby barangays. The main site was Brgy. Bagacay in Hinabangan municipality where the former mine land is located and the secondary sites were the barangays along Taft River: Malinao, San Pablo, Mabuhay, and Gayam. The secondary sites are located in the municipality of Taft, province of Eastern Samar.

Fig. 1 illustrates the locations of primary and secondary sites. In **Fig. 2**, the community resource map of Brgy. Bagacay is illustrated (map obtained from the community secretary).

[2] abbreviation of 'barangay'

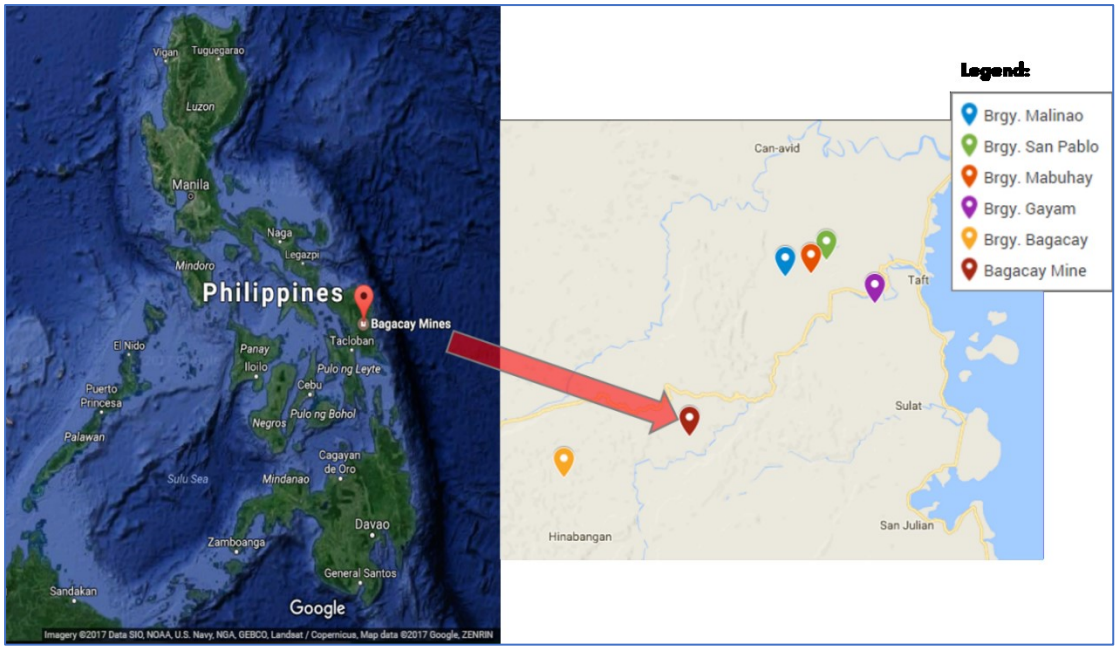

Fig. 1. Location of primary and secondary sites.

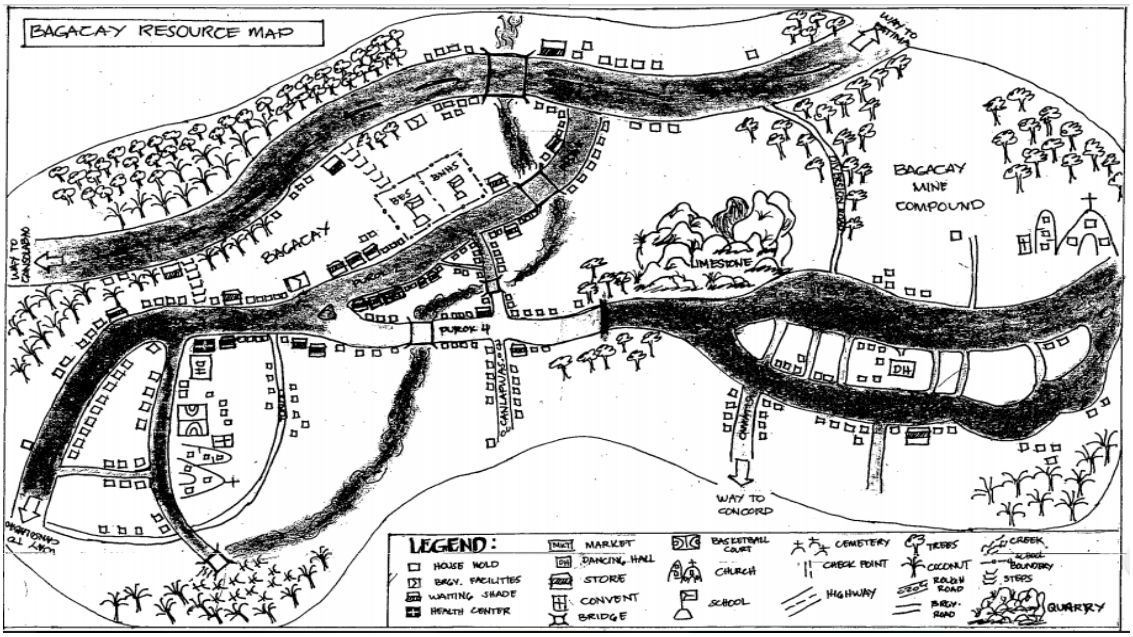

Fig. 2. Bagacay resource map.

3.2 Data collection and analysis methods

To obtain public perception on the impacts of mining and rehabilitation, both quantitative and qualitative methods were applied. Quantitative method included distribution of questionnaire surveys to random households (N=386) in the main site. Questionnaire surveys were written both in English and *Waray*, the local language in the area[3]. Local residents were hired as research assistant and enumerators in order to ensure data integrity when translating the answers from *Waray* to English. The total number of valid respondents was 123. Qualitative method employed focus group discussions (FGDs) with selected members of the community. KIIs with the community leaders of the secondary sites further supported the validation. Data validation was done through semi-structured interviews with officials of concerned government agencies in Samar (MGB Regional Office/MGB-VIII and SINP Office). Data gathering was done simultaneously. The study applied descriptive statistics using IBM SPSS Statistics 20 and Microsoft Excel 2016.

Similarly, data from the MGB-Central Office (MGB-CO), ERDB, and PMO were obtained through semi-structured interviews with their respective representatives and were analyzed using the content analysis method. An interview with *Alyansa Tigil-Mina*, a non-government coalition challenging the promotion of destructive large-scale mining in the Philippines, was also carried out via email. These interviews were conducted separately from the field survey in Samar.

Table 2 summarizes a list of data collection instruments used and key topics covered.

Table 2. Data collection instruments.

Instrument	**Key topics covered**
Institutional Document Review Bagacay Mine Rehabilitation Project: Project Completion Report 2014 (MGB-CO and ERDB)	Background of the Component Objectives and Targets Planned Outputs and Outcomes Loan and Grant Agreement and Project Appraisal Document

[3] The actual questionnaire used during the field survey is attached in Appendix A.

Report on the 1st and 2nd Quarters, CY 2017 Monitoring of the Implementation of Rehabilitation in Bagacay Mine (MGB-RVIII) An Integrated Science-Based Approach in the Rehabilitation of Mined-Out and Waste-Dump Areas in Bagacay, Hinabangan, Samar (ERDB) Samar Island Natural Park Management Plan 2016 (DENR)	Program Cost and Financial Performance Planned vs. Actual Implemented Strategies Achievements Impacts, Trends and Emerging Patterns Insights and Lessons Learned Recommendations Historical context and planning framework of the protected area Description and situational analysis of SINP General management plan of SINP Implementation plan
Literature Review	Definitions of rehabilitation and related terminologies AML rehabilitation cases in other countries AML rehabilitation cases in the Philippines Stakeholder involvement in AML rehabilitation Environmental justice in mine-affected areas
Questionnaire survey 62 items with 14 subitems 7 sections 9 Demographic questions 2 Yes/no questions 2 Multiple choice questions 47 Likert scale type questions 11 Descriptive type sub-questions 3 Scale type sub-questions 1 Ranking type question 1 Open-ended question	Demographic Information Background on previous mining involvement Awareness on the rehabilitation efforts in Bagacay Perception on Environmental Impacts of rehabilitation Perception on Health Impacts of rehabilitation Perception on Socio-economic Impacts of rehabilitation Perception on the importance of rehabilitation components Overall remarks on the rehabilitation efforts
Focus groups Semi-structured 7 Predetermined questions Additional probing questions	History of Bagacay Experiences regarding the effects of mining Perception of the rehabilitation efforts Components of a successful rehabilitation project
Key informant interviews At least 5 Predetermined questions Additional probing questions	History of mining in Bagacay History of their barangay compared to Bagacay Effects of mining in their area Awareness on the rehabilitation efforts in Bagacay Current state of environmental and socio-economic state in their area

Individual interviews with government officials Semi-structured At least 10 Predetermined questions Additional probing questions	General state of AMLs in the Philippines Legal definition of AMLs Legal definition of responsible mining Mining Act Criteria for declaring AMLs Reason for choosing Bagacay Mine as a priority rehabilitation project Rehabilitation method used Components of rehabilitation Rehabilitation funds Decision-making process Institutional involvement Challenges Future plans for the rehabilitated area

3.2.1 The Spearman's rho test for variable correlation

Spearman's rho (ρ) is used in the correlation analysis of variables that are both ordinal or if one variable is ratio/interval (Bryman, 2016). Since the data types were mostly ordinal and ratio, Spearman's rho was selected as a correlation test method based on Bryman's table on bivariate analysis methods (**Table 3**). The value of ρ will range from 0 to 1 and will assume either a positive or a negative value. This describes the strength of correlation between two variables. The following is a guide for interpreting value of Spearman's rho based on the web <statstutor.ac.uk>:

.00-.19 - "very weak"
.20-.39 - "weak"
.40-.59 - "moderate"
.60-.79 - "strong"
.80-1.0 - "very strong"

However, the Spearman's rho value is only significant at sig. value of 0.05 or lower.

Table 3. Bivariate analysis methods. (extracted from Bryman, p. 340)

	Nominal	**Ordinal**	**Interval/ratio**	**Dichotomous**
Nominal	Contingency table + chi-square (χ^2) + Cramer's *V*	Contingency table + chi-square (χ^2) + Cramer's *V*	Contingency table + chi-square (χ^2) + Cramer's *V* If the interval/ratio variable can be identified as the dependent variable, compare means + eta	Contingency table + chi-square (χ^2) + Cramer's *V*
Ordinal	Contingency table + chi-square (χ^2) + Cramer's *V*	Spearman's rho (ρ)	Spearman's rho (ρ)	Spearman's rho (ρ)
Interval/ratio	Contingency table + chi-square (χ^2) + Cramer's *V* If the interval/ratio variable can be identified as the dependent variable, compare means + eta	Spearman's rho (ρ)	Pearson's *r*	Spearman's rho (ρ)
Dichotomous	Contingency table + chi-square (χ^2) + Cramer's *V*	Spearman's rho (ρ)	Spearman's rho (ρ)	phi (φ)

3.3 Ethical considerations

Research communication letters were sent in advance to the respective participants (i.e., letters to the community leader of Brgy. Bagacay, Hinabangan town mayor, and to every government office involved in the rehabilitation). During the fieldwork, courtesy calls with the Hinabangan mayor, barangay captain of Bagacay, and regional offices were done before conducting interviews. A letter of intent signed by the researcher and with the approval of the barangay captain was shown to participants during the questionnaire survey proper for them to understand the purpose of the research. Moreover, the identities of the respondents were not disclosed in the results and discussion.

4. RESULTS AND DISCUSSION

Results of the study were presented in two parts: 1) results from interviews with representatives of the government agencies involved in the rehabilitation program; and 2) field survey results.

4.1 Results from interviews with government agencies and official document analysis

This section discusses the findings from face-to-face and e-mail interviews with the representatives of the concerned government offices: DENR-MGB (both Central and Regional Offices), DENR-ERDB, PMO, and SINP Office; and the data findings from official documents obtained from the same offices. The results shown here answer the research questions 1, 2, 3, and 5.

4.1.1 Chronology of mining operations in Bagacay and jurisdictional legislations in the Philippines

Based on the official documents acquired from government offices, a chronological timeline of the mining operations in Bagacay along with the legislations was constructed (**Table 4**).

Table 4. Chronology of mining operations in Bagacay and jurisdictional legislations in the Philippines.

Year	Activity
1956	Copper mining in Bagacay Mine under the Marinduque Mine Industrial Corporation (MMIC)
1986	Pyrite mining under the Philippine Pyrite Corporation (PPC)
1992	Termination of PPC operations due to high recovery cost and labor disputes
1995	Enactment of Philippine Mining Act of 1995[4]
1996	Declaration of SINP as a forest reserve
2003	Establishment of SINP as a natural park

[4] calls for the rehabilitation of mined-out areas but only applicable to the current mining operations

2004	Issuance of National Policy Agenda on Revitalizing Mining in the Philippines (E.O. 270)[5]
2005	Privatization and Management Office (PMO) under the Department of Finance (DOF) took the management of the former Bagacay Mine
2007	Limestone rock dam was installed by the MGB in the Bagacay Mine as an initial pollution control measure
2009	Phytoremediation research of the ERDB commenced

4.1.2 Government offices involved

Different government agencies were involved in the rehabilitation program in the former Bagacay Mine. Their relationships can be illustrated in two ways: **Fig. 3** presents them as an organizational chart, while **Fig. 4** shows the power relationships among these government offices.

As shown in **Fig. 3**, the DENR and DOF are the two bigger government organizations that handle the three key players in the rehabilitation: MGB, ERDB, and PMO. If viewed as an organizational chart, it may look like the DENR and DOF have equal authority when it comes to decision-making for the Bagacay Mine. However, the power relations map in **Fig. 4** illustrates that DOF is responsible for the supervision of the PMO, with the latter being in authority for the overall management and decision-making concerning the Bagacay Mine.

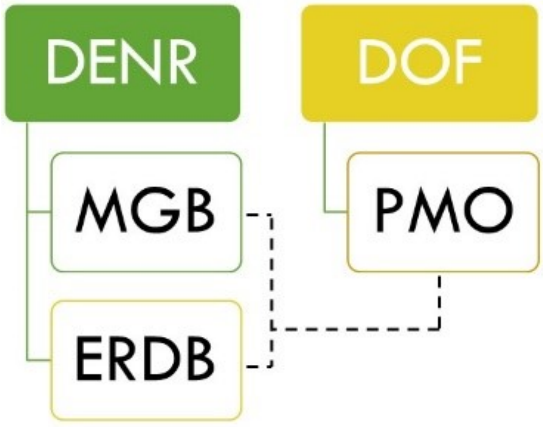

Fig. 3. Government offices as an organizational chart.

[5] calls for the "remediation and rehabilitation of abandoned mines"

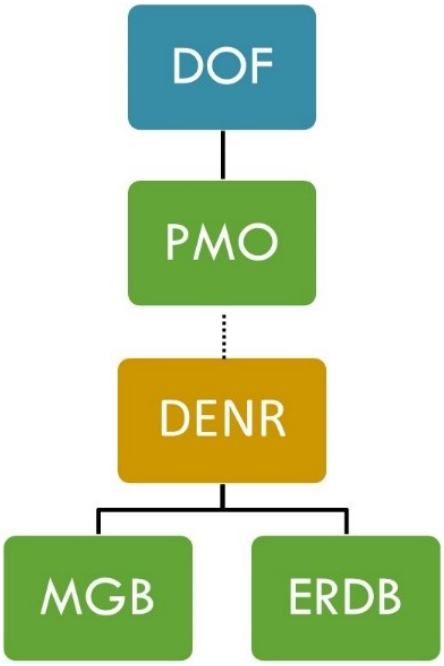

Fig. 4. Power relationships among the government offices.

While the rehabilitation efforts are being carried out by the DENR, the Bagacay Mine is currently under the custody of the PMO. The PMO was created in November 17, 2005 by virtue of Executive Order 471 to act as the administrator of the Bagacay Mine. It took over the Asset Privatization Trust (APT) which was established in 1986 to control the properties and assets of MMIC that was foreclosed by the Philippine National Bank (PNB). One of these properties that was transferred to APT was the Bagacay Mine (MGB and ERDB, 2014). The DENR was the office that proposed the rehabilitation project, and the implementation is the responsibility of its two bureaus: MGB and ERDB. The former is responsible for the construction of pollution control structures while the latter is the research leg of the project. The ERDB established experimental plots in the site to identify which plants are suitable for growth (detailed explanation in **section 4.1.4**). Even so, during the project implementation, the MGB and ERDB still need to inform the PMO of every task that they need to carry out in the site. A gate pass must also be obtained from the PMO to be able to execute their project objectives.

4.1.3 Declaring a mine site abandoned

When asked about abandoned mines, the MGB-CO representative during an interview in 2017 said, *"Frankly speaking, in the law, we don't have a definition of abandoned mines. But we put in there like, the textual definition. Abandoned mines don't have an existing contract, tenement, and its owner is already gone.*[6]*"* Basing on this definition, mines that have been deserted by the owner is the sole criteria for declaring a mine site abandoned, and that answers the first research question. This basic finding is consistent with research stating that several authorities do not differentiate the terms related to AMLs such as "abandoned", "orphaned", "derelict", and "ownerless", among others (Brehaut, 2008).

4.1.4 The Bagacay Mine rehabilitation program of the DENR

This includes discussions on the specific rehabilitation methods used and the basis for choosing them, as well as the criteria for successful rehabilitation. Hence, answering research questions 2 and 3.

Since the operational shut down in 1992, there were no rehabilitation and maintenance initiated in the 137.5 ha former Bagacay Mine. However, since the E.O. 270 of 2004 called for the rehabilitation of abandoned mines, the Bagacay Mine rehabilitation was prioritized through the National Program Support for the Environment and Natural Resources Management Project (NPS-ENRMP) funded by the World Bank. Numerous researches and investigations were conducted in the site from 1999 to 2012 (MGB and ERDB, 2014) which led to the commencement of the rehabilitation program. The list of activities is summarized in **Table 5**.

[6] Based on an interview with Engr. Marcial Mateo of the Mine Safety, Environment and Social Development Division of the MGB-CO conducted on Nov. 8, 2017 at the MGB-CO in Diliman, Q.C.

Table 5. Highlights of the rehabilitation efforts in Bagacay Mine.

Year	Activity
1999	Sangguniang Bayan (SB) of Taft, Eastern Samar conducted a study that recognized the degradation of Taft River; sought budget for the rehabilitation of the river
2000	MGB RO No. VIII submitted a "Report on the Assessment of Mine Affected/Abandoned Areas of Philippines Pyrite Corporation"
2001	MGB-DENR commissioned TETRA TECH EM, Inc. to conduct a "Semi-detailed Assessment of Abandoned Mines in the Philippines"
2003	MGB conducted a "River Assessment and Water Quality Monitoring of Taft River"; suggestions include silt dredging and planting of appropriate tree species
2004	MGB-VIII conducted a rapid appraisal of the Bagacay Mine, as per DENR Special Order No. 2004-74, "Rehabilitation of Abandoned Mined-out Areas in Samar Island"
2005	MGSD, MGB Central Office (CO) submitted a "Preliminary Report on Taft River and the Coastal and Nearshore/Offshore Environment of Taft, Eastern Samar" from their geo-environmental study along the downstream portion of Taft River and the adjacent Coastal and Nearshore/Offshore areas which are the main receiving bodies of water from the Bagacay Mine
2006	World Bank consultants visited Bagacay Mines and suggested MGB-CO to conduct an assessment of the abandoned Bagacay Mine; Geotechnical Assessment of the Tailings Dam of Bagacay Mine was undertaken
2007	Limestone rock dam was installed
2008	"Detailed Engineering, Planning and Design for the Rehabilitation of Bagacay Mine" was completed by SR Metals Inc. (hired by MGB) but was evaluated as unfeasible
2009	ERDB started its research on phytoremediation
2010	ERDB submitted the "Hydrologic Behavior of Bagacay Watershed" report; MGB completed its geophysical survey: "Resistivity Profiling and VLF-EM Surveys at Bagacay Mine, Hinabangan Samar"
2011	Geohazard assessment for the possible route of the diversion channel/pipeline for drinking water was conducted
2012	Actual geotechnical study of the mine pits, waste dumps, tailings pond and other structures; monitoring and evaluation of the accomplishment of the Bagacay Mine Rehabilitation Project through a fieldwork conducted by World Bank representatives

The program which is entitled, "An Integrated Science-Based Approach in the Rehabilitation of Mined-Out and Waste-Dump Areas in Bagacay, Hinabangan, Samar" has the following objectives: "1) rehabilitate identified sites in Bagacay mined-out and waste-dump areas; 2) improve soil condition using potentially tolerant plants

(phytoremediation); and 3) restore the productive potential and aesthetic beauty of the site, which could be transformed into an ecotourism destination for both local visitors and foreign tourists. (ERDB and MGB, 2016).” The MGB-CO representative stated that they have allotted a budget of Php307M for the project, in which phytoremediation had a bigger allocation.

To fulfill the second research question, phytoremediation was the main method used in the rehabilitation wherein certain plant species were planted with the goal of either breaking down the heavy metals in the soil or absorbing and storing them into various plant parts. In 2009, ERDB planted the following species to the site: Narra (*Pterocarpus indicus*), Auri (*Acacia auriculiformis*), Mangium (*Acacia mangium*), Mt. Agoho (*Casuarina nodiflora*), and Vetiver (*Chrysopogon zizanioides* (L.) Roberty). Among these species, *Pterocarpus indicus* was found out to absorb heavy metals most efficiently based on the results of plant tissue analysis. Aside from phytoremediation, soil amelioration treatment was also employed. This uses a combination of forest soil, lime, and organic fertilizer that supported plant survival and growth performance (ERDB and MGB, 2016). The mobility of heavy metals in soil and their accumulation in the plant are decreased by the addition of lime. This is a common method used in soil neutralization (Sheoran et al., 2010). Based on the interview with the project leader in 2017, 50-hectare portion of the 137.5-hectare barren land has been rehabilitated by the ERDB and MGB as of that year. **Fig. 5** illustrates the vegetation growth between 2009 and 2016.

Fig. 5. Vegetation growth in Bagacay Mine between 2009 and 2016 (Photo extracted from ERDB and MGB 2016 report).

The methods employed by the ERDB and MGB tie well with previous studies stating that the present-day closure planning is a science-driven activity in contrast to the past wherein rehabilitation of mined-out sites was "sometimes driven more by public relations considerations than science (Limpitlaw and Briel, 2014)."

As for the criteria for successful rehabilitation, interview results with MGB-CO and ERDB convey that they have not come up with a concrete set of criteria yet. According to the MGB-CO representative,

"I can't say for now because we still don't have… We can't show any area yet. It should have been Bagacay. After we finish it we will declare it as successful. Of course, definitely, we are the ones to declare that it is successful. For example, the phyto [remediation], you can say that it is successful if the plants grow. Like, what is the survival rate? The foresters said it was successful. The research is okay.[7]*"*

MGB-VIII said the same thing, that they have no existing parameters to determine the success of the rehabilitation. And since ERDB is the one responsible for the conduct of phytoremediation, its representative was asked the same question in a separate interview, to which he replied,

"Ah, we're not yet declaring it as successful. We are not declaring it yet as very successful. But we can see the successes there. Because if you see it before, it was so bare. But now, the trees there are so alive… So, the thing that you were saying… actually, we are not yet declaring this very successful because we still have an on-going research there. But what we can say is, the indicators that we are successful: 1) the natural cycle in the life of a plant is already functioning. So, it means the tree now produces the biomass, the litter fall, the leaves, twigs, branches they are falling. Now, the litter fall decomposes, the tree takes it up again, that's why it's already alive. It's already alive. And indicators also show that the area is slightly getting better, there is already a degree of success; 2) there are undershrub. So, the continuous accumulation

[7] *Id.* at 6.

of litter fall on the ground triggered the growth of other species underneath. Another indicator is the pH. The pH there before is [was] 2, very acidic. Now it reaches 5.[8]*"*

The above-mentioned criteria imply that some success indicators were already in place to some extent but are not clearly established yet. Moreover, the said indicators are more focused on the environmental component of rehabilitation since they solely describe the results of phytoremediation. This is the response to the third research question.

When asked about the future plans for social rehabilitation, the ERDB representative answered,

"We have no future plans yet. Our hopeful plan is, as part of the future plan, is to develop it into ecotourism [area] so they will have livelihood other than mining. Because during the mining period, they were so alive there. It was very happy there. They were so happy. That's why many of them want the mining to be re-opened.[9]*"*

This statement was validated by the field survey results which are discussed comprehensively in **section 4.2.5**. These results support the first assumption that there is a need to incorporate the rehabilitation of all components in the Bagacay Mine rehabilitation program.

4.1.5 Realities of jurisdictional boundaries and actual project implementation

The lack of legal definition of abandoned mine land in the Philippines is a problem because even in the presence of E.O. 270, it will be difficult to assess which mines are the liability of the government and which are not when the term AML is not legally defined. Definitions should also identify the accountable party for the rehabilitation and the scope of responsibilities. Also, Bagacay Mine is within the borders of SINP (**Fig. 6**). This is problematic when future re-opening of the mine is considered because

[8] Based on an interview with For. Gregorio Santos, Jr. (project leader) of the ERDB conducted on Nov. 28, 2017 at the ERDB office in Los Baños, Laguna.
[9] *Id.* at 8.

strictly speaking, extractive activities are not allowed within the boundaries of a natural park, according to the law and the SINP PASu. In Section 4 of the National Integrated Protected Areas System (NIPAS) Act of 1992, it was mentioned that "extractive resource uses are not allowed [in a natural park] […] to protect outstanding and scenic areas of national and international significance for scientific, educational and recreational use (Samar Island Biodiversity Project, year not specified)."

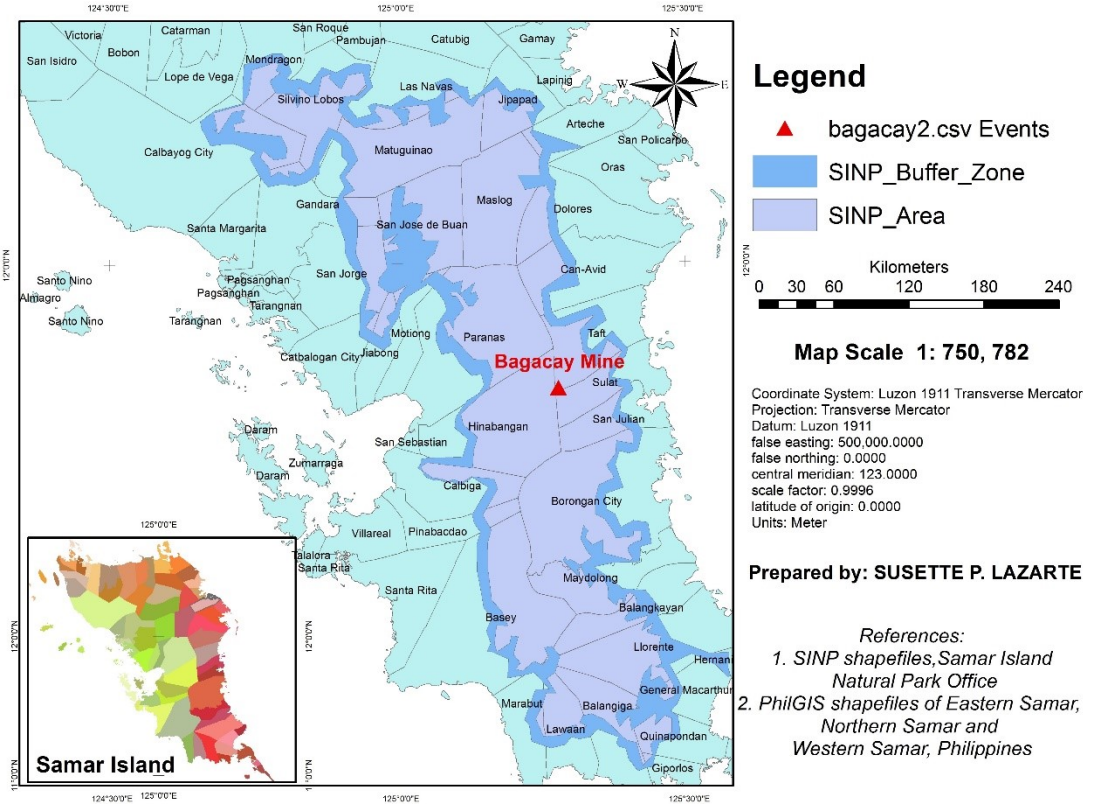

Fig. 6. Location of Bagacay Mine within SINP.

In terms of the project implementation, one recurring theme is that the rehabilitated area is not accessible to the public. A permit from the PMO needs to be secured before entering the site. Even the MGB and ERDB who execute the rehabilitation are not allowed to enter unless they have a permit. Additionally, the slow processing of permit is the major reason of delay according to them. However, based on the interview with the PMO, the MGB did not clarify their justification for ingress and egress in the site, and that is why they are not granted permit to enter the premises. This tension between these agencies slows down the progress of the program.

The program also operates disconnectedly from other government agencies. Although Bagacay Mine is within the borders of SINP, the SINP office is not involved in the decision-making process and not even consulted concerning the rehabilitation of the former mine. With regards to the pollution measure control and success parameters setting, the MGB-VIII representative stated during the interview that these are the responsibilities of the Environmental Management Bureau (EMB). However, these roles are not being taken up by the said agency at the time of the interview. Biodiversity experts from other government and non-government organizations, whose skills would be substantial towards the biodiversity restoration in the site, were also not being tapped for the rehabilitation project. The representatives from the ERDB and MGB also did not mention future collaborative works with other government agencies, NGOs, or experts.

4.1.6 Future land use plan for Bagacay Mine

Planning for the future land use of AMLs is important to prevent unsustainable use that has no benefit to the community (Tolentino, 2011). Rehabilitating an abandoned mine does not end in the success of reforestation. Aside from restoring some of its ecological functions, it should be useful to the community. AMLs can be converted into various land uses after thorough assessment of their potential and limitations such as contamination and other risks. They can be used as venues for cultural and recreational activities like nature trail, sports arena, dive sites and other similar activities (Kivinen, 2017). They can also be turned into development spaces such as industrial infrastructure and residential areas (Milgrom, 2008). To answer research question 5, all of the key agencies involved in the rehabilitation (MGB, ERDB, and PMO) were asked about the future plan for Bagacay Mine. According to the MGB, the PMO is going to sell the land in the future. However, the ERDB representative answered it differently:

"The alleged mineral deposits that are still there will be disposed. Because they believe that there are still stocks, stored. Because that's the claim of the former operator. There

are still stored resources in there. So that's what they are protecting. And that's what they are going to sell. But they can't, they have no right [to sell the land]", he said.[10] However, the PMO, which has the mandate to decide for the future land use of the site, responded to the e-mail interview that it is confidential[11]. This rejects the second assumption that re-opening of the mine is not considered in the future land use plan for the former Bagacay Mine since it is within the borders of SINP.

When asked about the extent of each office's involvement regarding the decision-making for the rehabilitation and future land use plan for the site, the ERDB representative replied,

"For as long as our services are still needed, then we will not hesitate to provide whatever technical assistance that we can provide. Because that is our mandate. But as to deciding what really is [the plan], we are not involved. Because it is the PMO who will decide.[12]"

In addition, both MGB-CO and MGB-RVIII stated the same regarding the matter ─ that it is the PMO that is going to decide what to do with the former mine site. The protected area superintendent (PASu) of SINP mentioned in the interview that their office is not engaged as well in the decision-making. Also, the Hinabangan town mayor and Brgy. Bagacay community leader said that they are not involved in the rehabilitation program of the Bagacay Mine, let alone the decision-making process for the site. The mayor said, *"In terms of planning and assessment of the mined area, the LGU has not taken action yet because even they are not allowed to enter the mined area.[13]"*

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[10] *Id.* at 8.

[11] Based on the interview answers provided by PMO via email on Jan. 22, 2018. The interview was originally intended to be face-to-face for better discussion flow but unfortunately, after numerous attempts on the schedule follow-up, the researcher was not given a slot due to the hectic schedule of the office.

[12] *Id.* at 8.

[13] Based on an interview with Hinabangan town Mayor Ellen Dieza conducted on Oct. 17, 2017. The researcher had to carry on with the interview at the mayor's house since government offices were closed that day due to transport strike.

In other words, the PMO decides alone regarding the future land use for the Bagacay Mine. Even the MGB, ERDB, local government unit (LGU), and community are not involved in the decision-making process. This is further corroborated by the field survey results which are specifically discussed in **section 4.2.2**. This rejects the third assumption that the LGU and community are involved in the rehabilitation program.

4.2 Field survey results

This section discusses the results from questionnaire surveys, FGDs and KIIs in the field sites, and answers research question 4, but also encompasses other research questions as ancillary data that will support other findings.

4.2.1 Basic information

This includes the demographic characteristics of the questionnaire survey respondents in Brgy. Bagacay. All basic information is presented in **Table 6.** The respondents were almost proportional – 50.41% male and 49.59% female, and majority are aged 51-60 (26.83%). In terms of educational level, majority are high school graduates (45.53%); 24.39% have bachelor's degree; and only 0.81% obtained a master's degree. Although agriculture is the main source of income in the area, there are more unemployed respondents (24.39%), than farmers (17.07%). The community is composed of six wards called *"purok"* which are all located outside the mine compound (71.5% of the respondents). In addition to the six *puroks*, there is an area within the mine compound called Sitio Sakob, the only *sitio* in Brgy. Bagacay where 28.5% of the respondents reside. A *"sitio"* is slightly similar to a *"purok"*, only the former is more rural and farther from the center of the barangay. Most households are composed of two to four people (43.9%). However, households composed of five to eight people is a close second, which is equivalent to 42.3% of the respondents. Majority of the respondents (43.1%) are residing in the community for over 40 years. Most households (52.8%) have an average monthly income of less than Php5,000 (less than JPY10,000). It is also noteworthy that 80.5% of the respondents have family members who used to work in the mine. In some cases, the respondents themselves were the former employees.

Table 6. Social and demographic characteristics of the respondents.

Socioeconomic characteristics	Freq	%
Gender		
Male	62	50.4
Female	61	49.6
Age Distribution		
below 20	1	0.8
20-30	19	15.4
31-40	14	11.4
41-50	22	17.9
51-60	33	26.8
61-70	21	17.1
71-80	12	9.8
81 and above	1	0.8
Level of Education		
No formal education	1	0.8
Elementary	28	22.8
High school	56	45.5
Bachelor's degree	30	24.4
Master's degree	1	0.8
Vocational/technical	7	5.7
Occupation		
Farmer	21	17.1
Fisherman	3	2.4
Unemployed	30	24.4
Government official	10	8.1
Company employee	1	0.8
Artist	1	0.8
Self-owned business	13	10.6
Student	3	2.4
Retired	19	15.4
Others	22	17.9
Residency		
Outside mine compound	88	71.5
Within mine compound	35	28.5
Years of Residency		
Less than 5	3	2.4
5-10	3	2.4
11-20	13	10.6
21-30	23	18.7
31-40	28	22.8
more than 40	53	43.1
Household size		
2-4 people	54	43.9
5-8 people	52	42.3
more than 8 people	17	13.8
Household income		
Less than Php5,000	65	52.8
Php6,000-10,000	25	20.3
Php11,000-20,000	9	7.3
Above Php20,000	9	7.3
Classified	15	12.2

Former Mine Employee in the Family		
Yes	99	80.5
No	24	19.5

4.2.2 Awareness on the rehabilitation efforts

The residents of Brgy. Bagacay were asked regarding their awareness on the rehabilitation process being done in the former Bagacay Mine. **Fig. 7** shows that 53.66% of the residents are aware, while 46.34% are unaware. Of those who are aware of the rehabilitation program, 86.6% (percent of cases) are aware of the environmental component, while the other three rehabilitation components have remarkably low awareness percentages[14]. (**Table 7**). **Table 8** shows the sources in which the aware respondents obtain the knowledge on the rehabilitation from[15]. The highest source of information is personal communication (i.e. friends, family, colleagues) which is equivalent to 52.2% (percent of cases). This is followed by the official document from the government offices (28.4%); Information and Education Campaign (IEC) by the government (25.4%); printed media (4.5%); and very few acquired information from social media (3.0%) since there is no telecommunication signal in the area.

These results further reject the third assumption that the community is involved in the rehabilitation and decision-making since more than half of the respondents are unaware of the rehabilitation program of the government. Results from FGD further supports this data. According to the residents, *"We don't know what is happening there [Bagacay Mine]. We could have provided assistance with the rehabilitation but we have no knowledge of it because we are not informed.[16]"* However, ERDB claims that public consultations were made.

[14] Respondents were allowed to pick more than one option.
[15] *Id.* at 14.

[16] Based on the FGD with selected male participants conducted on Oct. 26, 2017 at the Bagacay barangay hall.

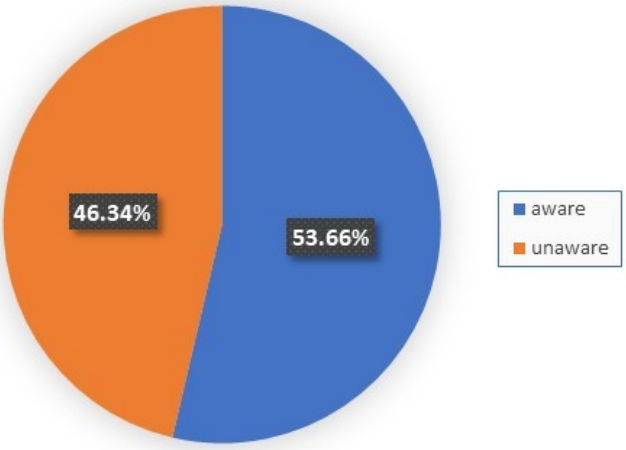

Fig. 7. Awareness on the rehabilitation program.

Table 7. Awareness component frequencies.

		Responses		Percent of Cases
		N	Percent	
Frequencies of awareness components[a]	Environmental	58	78.4%	86.6%
	Public safety	5	6.8%	7.5%
	Public health	5	6.8%	7.5%
	Socio-economic	6	8.1%	9.0%
Total		74	100.0%	110.4%

a. Dichotomy group tabulated at value 1.

Table 8. Information source frequencies.

		Responses		Percent of Cases
		N	Percent	
Frequencies of info source[a]	Official document	19	25.0%	28.4%
	Printed media	3	3.9%	4.5%
	Social media	2	2.6%	3.0%
	Personal communication	35	46.1%	52.2%
	IEC	17	22.4%	25.4%
Total		76	100.0%	113.4%

a. Dichotomy group tabulated at value 1.

4.2.3 Perception on environmental impacts

Perception regarding the environmental impact of rehabilitation was also determined. On the issue of bringing back the forest in the former Bagacay Mine, 56.1% (aggregate

of agree and strongly agree) of the respondents agree that the rehabilitation efforts help bring back the forest in the area (**Fig. 8**). However, when asked about the faunal component of the biodiversity, only 36.59% agree that the animals are coming back to the site because of the rehabilitation. Majority of the respondents (52.03%) are unsure about the issue, as shown in **Fig. 9**. Regarding their satisfaction with the rehabilitation efforts in terms of reducing the overall pollution, there is an almost equal percentage of respondents who are unsure if they are satisfied (36.59%) and respondents who are satisfied (36.58%), as shown in **Fig. 10**.

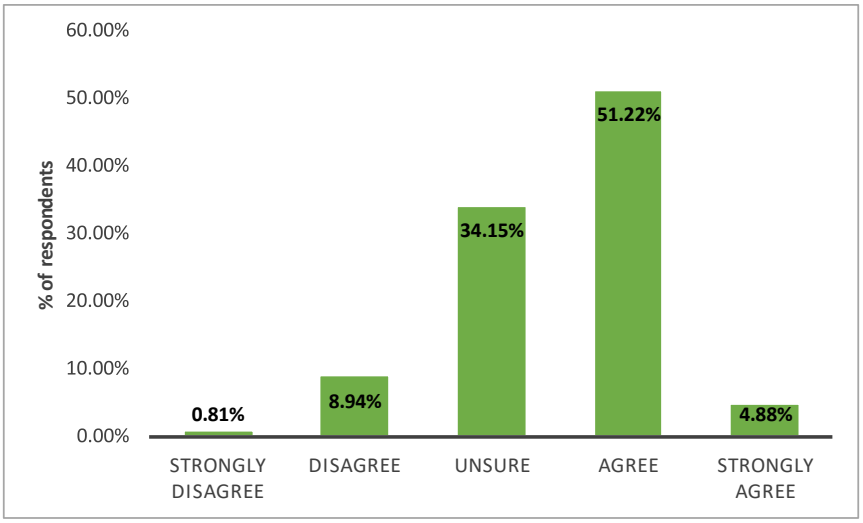

Fig. 8. Perception on the rehabilitation efforts in terms of bringing back the forest in the former Bagacay Mine.

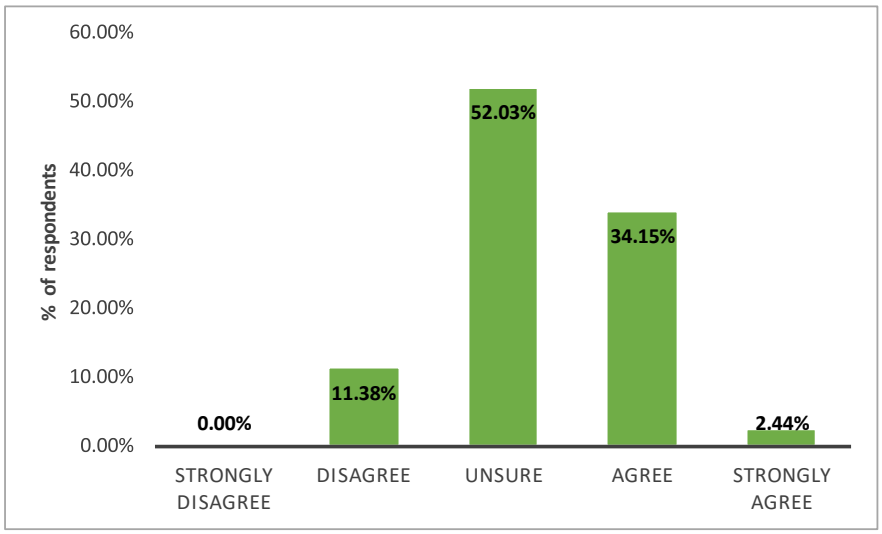

Fig. 9. Perception on the rehabilitation efforts in terms of helping bring back the animals to the site.

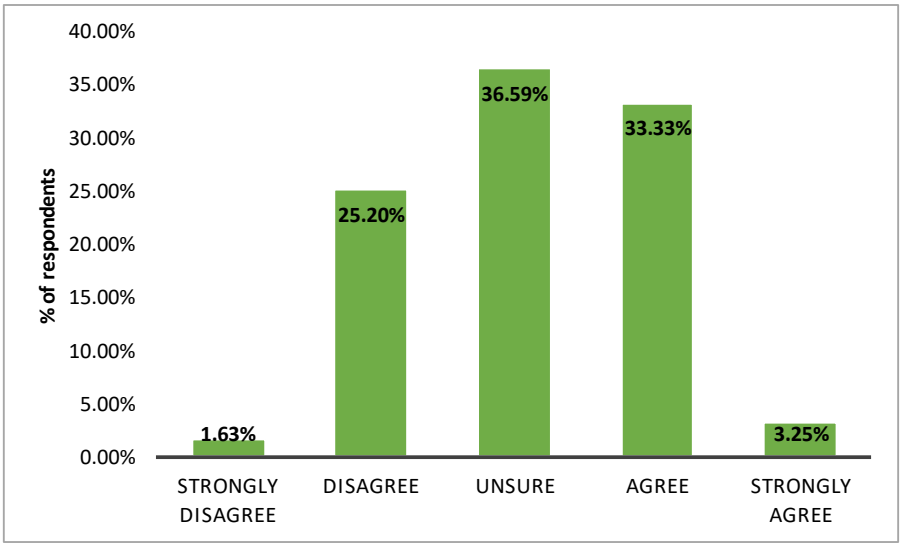

Fig. 10. Overall satisfaction with the rehabilitation efforts.

The uncertainty of opinions regarding the environmental impacts of the rehabilitation in the Bagacay Mine is mostly rooted in the fact that the residents are not allowed to get into the site. During the FGD, one participant stated, *"We don't know. What we hear, is just what we hear. We actually can't see what is happening there inside*[17]*"*, to which everyone agreed.

However, there are accounts of environmental damages that are directly associated with both the presence and absence of mining in the area. Based on FGD results, there were minimal forest denudation during the mining period. The residents back then were still not looking into forest resources as a source of livelihood because the mining companies were providing jobs for them. To quote, one participant said, *"There were no flooding and landslides when there were mining operations because the forests were not severely affected. There were still a lot of trees.*[18]*"* Another participant stated, *"Illegal logging worsened when mining operations shut down. This was when illegal charcoal-making proliferated. Charcoal makers cut even the young trees.*[19]*"* This is further supported by the statement of the Hinabangan town mayor during an interview in 2017. According to her, *"After the mine closed, logging became the source of income*

[17] *Id.* at 16.
[18] Based on the FGD with selected female participants conducted on Oct. 24, 2017 at the Bagacay barangay hall.
[19] *Id.* at 18.

of the people.[20] *"* Even so, recent floodings have also been linked to the siltation of the Taft River which is caused by the heavy metals from the former mine. According to one participant,

"When it rains, Taft River overflows. At the same time, the other river, Ulot River also overflows. So, we are trapped here because of these two rivers. It happened to us before. The residents from the east were unable to pass through. As a result, their products were not facilitated. Sometimes it takes a week. It's a good thing that our place is situated on high elevation. Now, the question [problem] is [that] we don't have [a] hospital here. If there is an emergency, we are trapped here. We have [an] ambulance so [but] where will we go?[21] *"*

Environmental problems were also noted by the residents along Taft River. One common theme during the interviews with the community leader of each barangay was flooding. From the words of the barangay captain of Malinao,

"The coconut plantations along the river, they used to bear fruits. The root crops, they were gone now. The trees also died. Then the time came when there's really nothing there. One problem that came to us was flooding. Why? Because along the river, nothing holds the soil anymore when it's raining hard because we are a catch basin here, catch basin from Bagacay.[22] *"*

4.2.4 Perception on health impacts

To determine the perception on health impacts of the rehabilitation, categories were divided into: poisoning from toxic metals, skin problems, and overall health issues. With regards to poisoning from toxic metals, majority of the respondents agree that there were no reported cases (64.22% combined agree and strongly agree), as shown in

[20] *Id.* at 13.
[21] *Id.* at 16. The participant was explaining his point to the group using illustrations.
[22] Based on the interview conducted with Capt. Nicanor Adao, barangay captain of Malinao, conducted on Oct. 25, 2017. The researcher went directly to the house of the interviewee because no communication letter was sent to him beforehand due to the lack of telecommunication signal in the area.

Fig. 11. Likewise, 60.97% of the respondents agree that there were no reported cases of skin problems caused by the water flowing from Bagacay Mine (**Fig. 12**). **Fig. 13** illustrates that 59.35% of the respondents agree that there were less health issues related to mining pollution when the rehabilitation began.

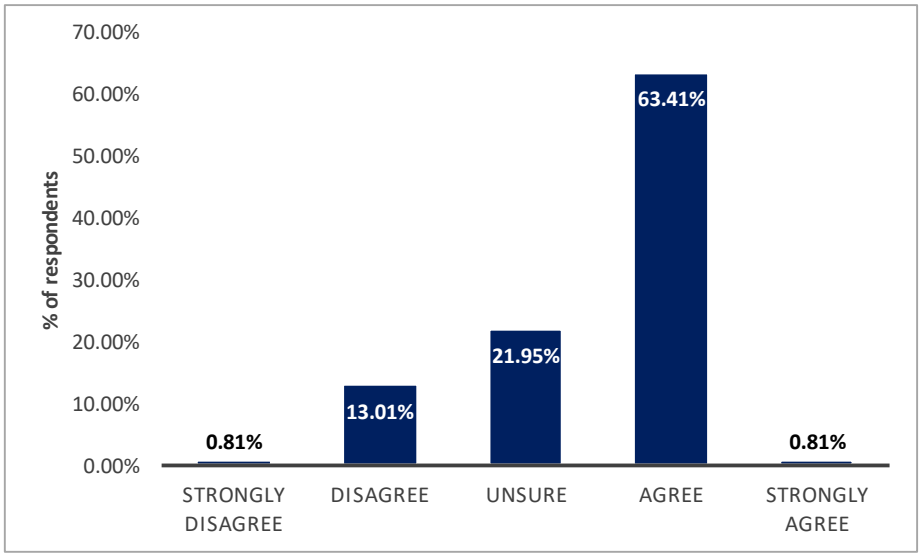

Fig. 11. Perception on non-poisoning from toxic metals.

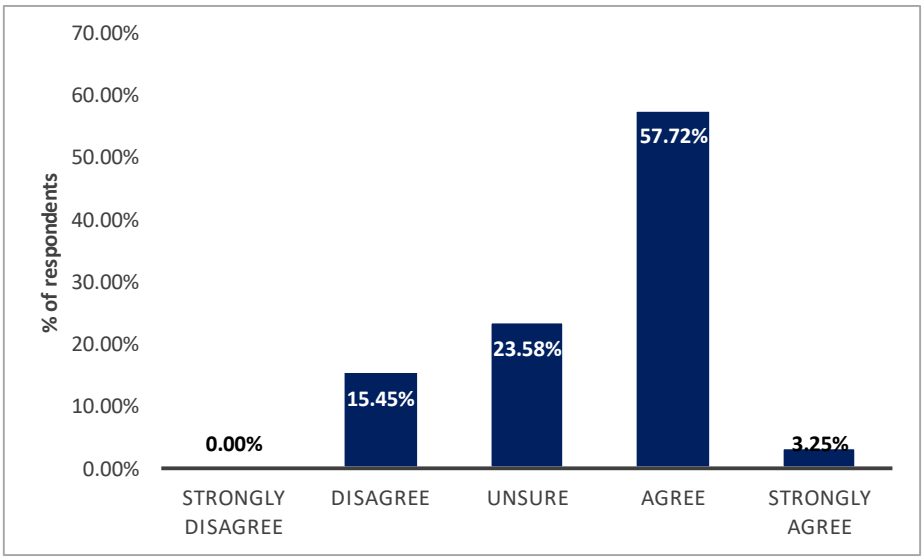

Fig. 12. Perception on the absence of skin problem cases.

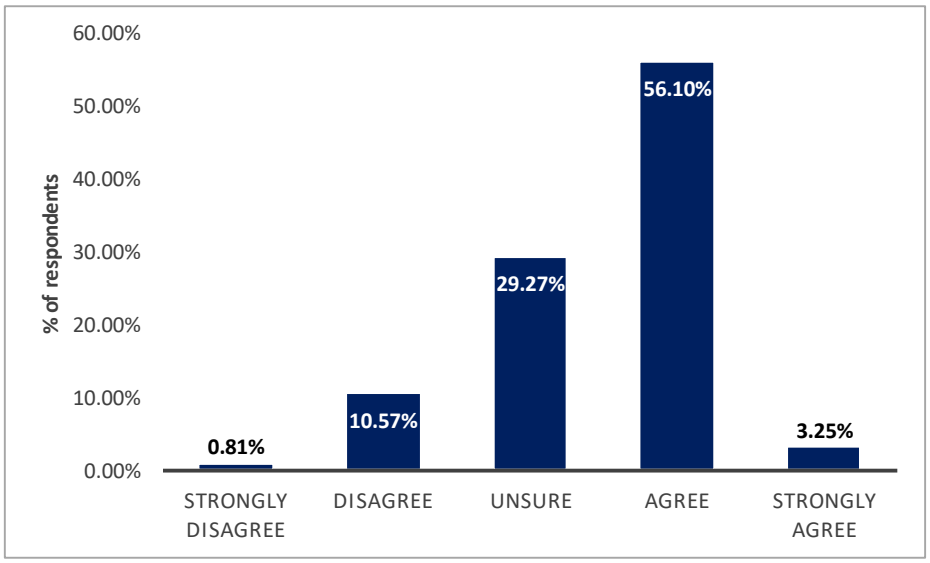

Fig. 13. Perception on having less health issues.

During the FGD, no particular health issues in Brgy. Bagacay were mentioned by the participants. However, they advised the researcher to ask the community residents along the Taft River if they have experienced health problems during and after the mining operations. Similarly, there were no accounts of any health issues in the secondary sites.

Public health is not of major concern since there was no outbreak of any serious disease in the past, as well as in the present. The threat in public health is not as grave as in other former sites where toxic metals were previously mined. For example, a closed mercury mine in southeast of Manila dumped its mine tailings amounting to roughly 1,000,000 t to into Honda Bay, Palawan which subsequently caused "increasing complaints of unusual symptoms" by the residents in the area (Maramba et al., 2006).

4.2.5. Perception on socio-economic impacts

Perception on economic impacts include the availability of rehabilitation results to the public, perceptions on family income before, during, and after mining, and economic stability. **Fig. 14** shows that 40.65% of the respondents agree that there were community consultations done regarding the rehabilitation of Bagacay Mine. However,

there is also a considerable percentage of respondents who are unsure if consultations were done (39.84%). On Information and Education Campaigns (IECs) conducted by the government, 49.59% agree that IECs were performed, while 33.33% are unsure about it (**Fig. 15**). When asked regarding the availability of rehabilitation results, 52.85% agree that results are available to the public, while 30.08% are not sure (**Fig. 16**).

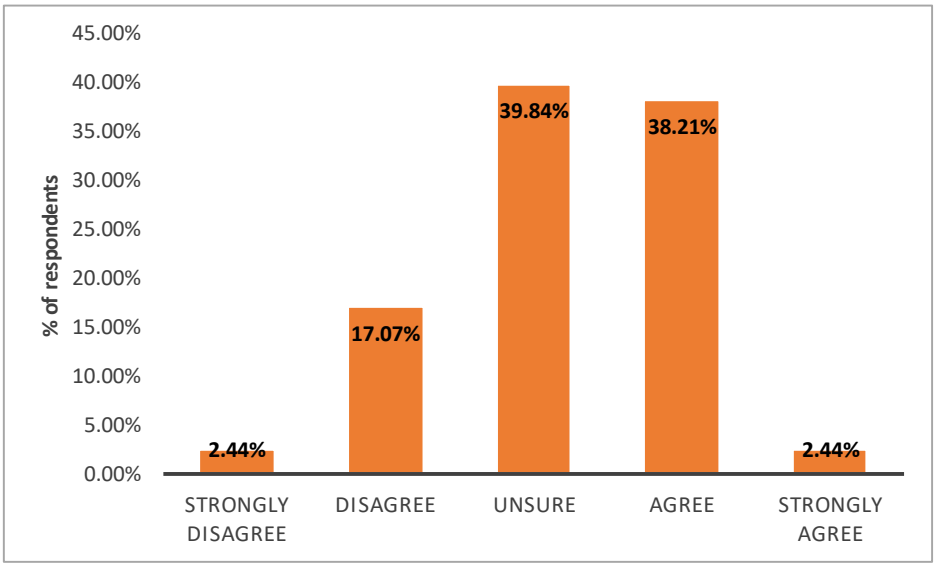

Fig. 14. Perception on the conduct of community consultations.

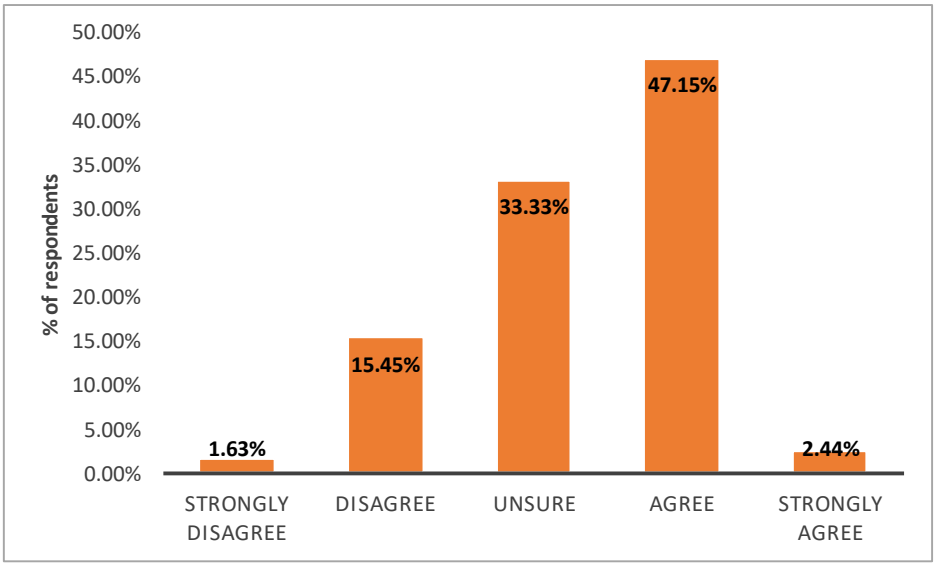

Fig. 15. Perception on the conduct of IECs.

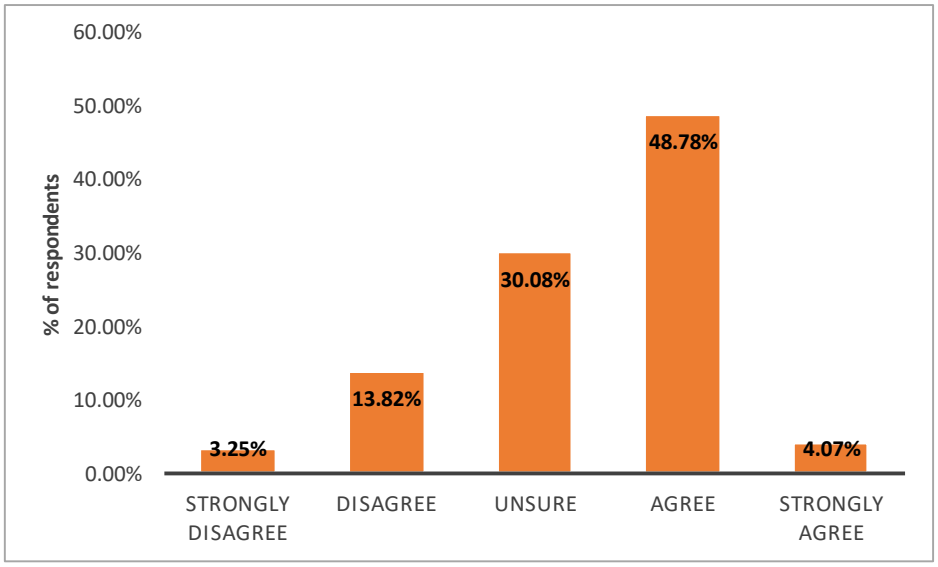

Fig. 16. Perception on the availability of results to the public.

Furthermore, in the conduct of community consultations regarding the rehabilitation program, the residents said that there were none. During the FGD, one participant expressed, *"Maybe the government has programs to rehabilitate the area. They are doing that but the LGU here is not notified. Because there was no general assembly held to talk [about] the rehabilitation.*[23]*"* Also, the town mayor said that the plans for the mined area are not being discussed at the LGU level. However, contrary to the claim of the residents that no consultations were done, ERDB representative stated, *"...when we first went there, because before we started [rehab] there, we really had a public consultation. We talked to the mayor, we talked to the barangay, we talked to the community.*[24]*"* This response from the ERDB is supported by the official progress report on the Bagacay Mine Rehabilitation Project (MGB and ERDB, 2014). According to the document, courtesy calls were conducted on March 16, 2010 with the municipal officials and barangay leaders. The discrepancy in the responses of the community and the ERDB is caused by the timeline difference between the courtesy calls which was conducted in 2010 and the field survey which was carried out in 2017. Since the meeting in 2010 was held under the old administration, current officials will generally say that there were no consultations done.

[23] *Id.* at 16.
[24] *Id.* at 8.

However, courtesy calls are different from consultations. While the latter means stakeholder involvement, in this case the LGU in the rehabilitation project, the former only informs the LGU of the rehabilitation plan for the abandoned mine. Furthermore, the consultation was done only once and there were no recent reports regarding courtesy calls at the LGU level. The government should move from courtesy calls to consultation and actually involve the LGU and community as stakeholders in the rehabilitation project. A detailed discussion of this is in **Section 7.3**.

Perceptions on family income before, during, and after mining were also determined. **Fig. 17** shows the perception on family income before mining. Majority of the respondents disagree that they have more family income before mining (45.53% aggregate of disagree and strongly disagree). On the other hand, when asked about their family income during mining, 80.48% agree that their income increased (**Fig. 18**). However, on the perception on family income after mining, results show that majority of the respondents (47.96%) agree that they have more income even after mining (**Fig. 19**). This is because when the mining operations shut down, the former employees had already sent their children to school. Based on the FGD, they became professionals and were able to contribute to the family income.

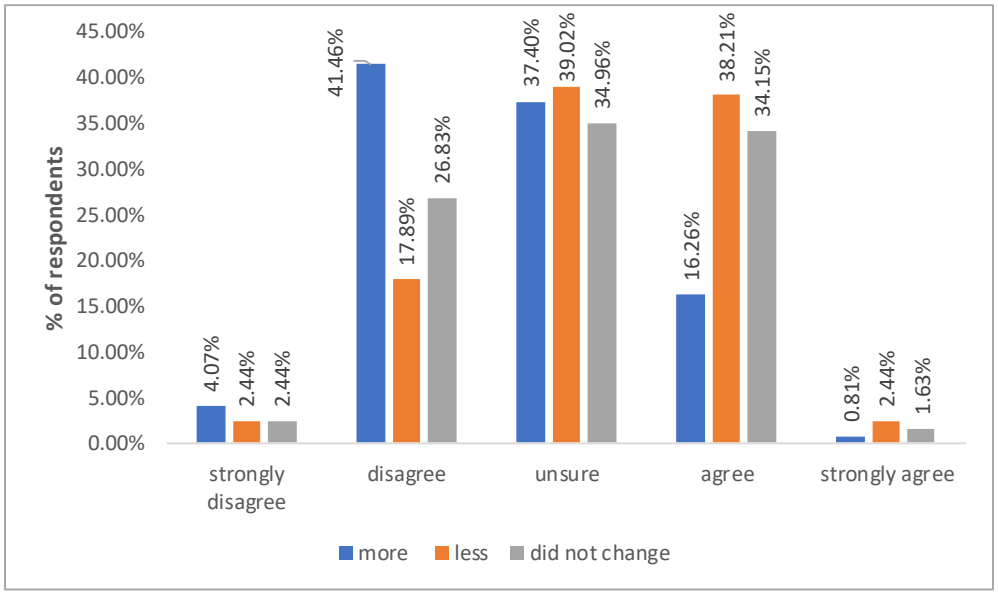

Fig. 17. Perception on family income before mining.

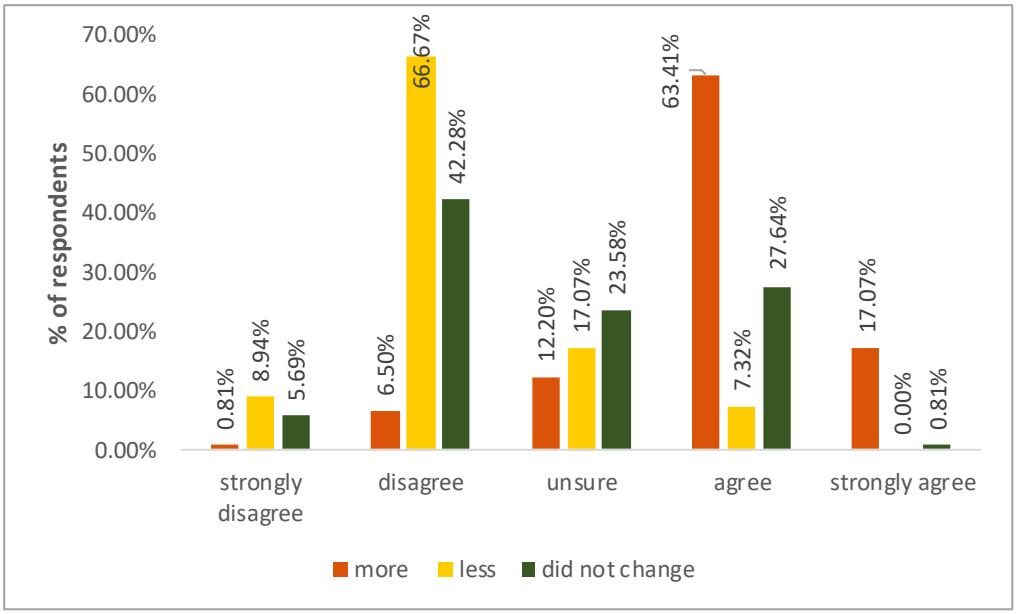

Fig. 18. Perception on family income during mining.

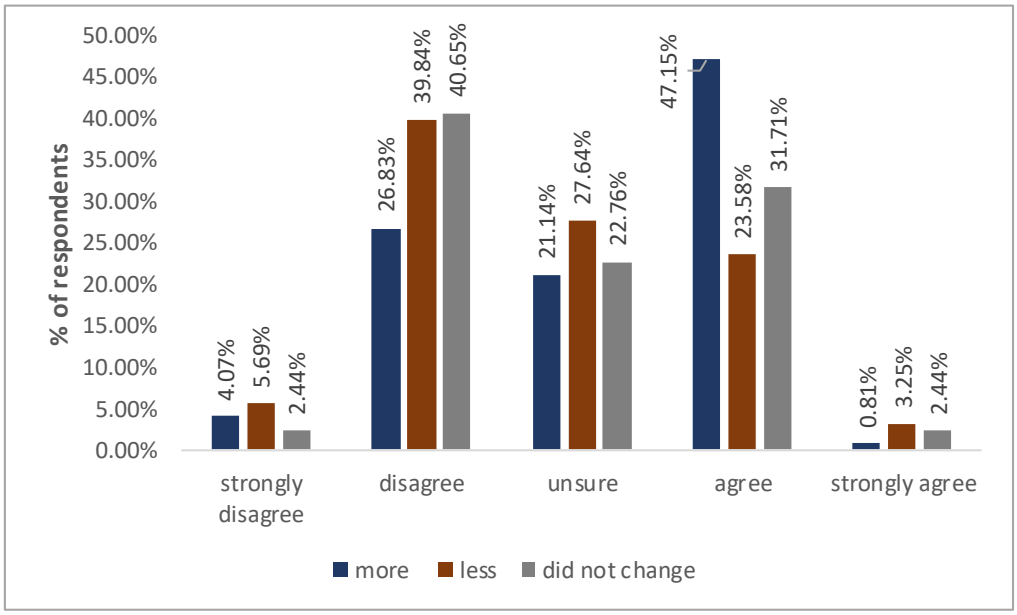

Fig. 19. Perception on family income after mining.

Fig. 20 illustrates the perception on economic contribution of mining in Bagacay. Majority of the respondents (91.05%) agree that mining helped the economic development in the local community. But despite this, most of the respondents (49.6%) agree that Samar's economy can be stable even without mining (**Fig. 21**). However, when asked if the remaining minerals in the former Bagacay mine should be re-mined, majority (64.23%) agreed to perform extractive activities again (**Fig. 22**). Of the 49.6%

who agreed that there can be economic stability even without mining, 31.71% agreed (aggregate of agree and strongly agree) to the re-opening of the mine (**Fig. 23**). This is further supported by the results from FGD wherein the participants stressed out the importance of mining as a source of their livelihood. According to them, *"We had so many benefits like free hospitalization and recreational facilities when Bagacay Mine was still open. We were so prosperous that we have sent our children to school. But when it closed, everything was gone.*[25]*"* One of them even compared the revenues from mining in contrast with rehabilitation. The participant stated, *"For me, about the rehabilitation of the mined area… the plants are growing there and then the mine is beneath it. My question is, where can the government get bigger profits, from mining or from those trees?*[26]*"* This means that in a greater scale of stability, the residents believe that the absence of mining in Samar will not hinder economic growth. This may be due to the presence of other economic activities in the whole province. However, in the community level, they still have a firm stance that the Bagacay Mine should re-open since it was their primary source of livelihood.

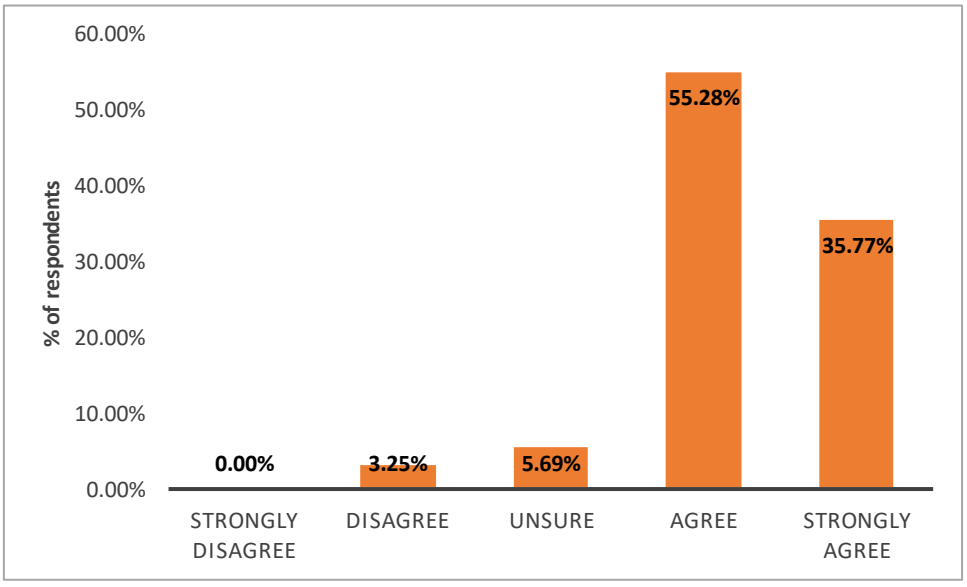

Fig. 20. Perception on the economic contribution of mining.

[25] *Id.* at 18.
[26] *Id.* at 16. The participant was talking to both the researcher and the FGD group.

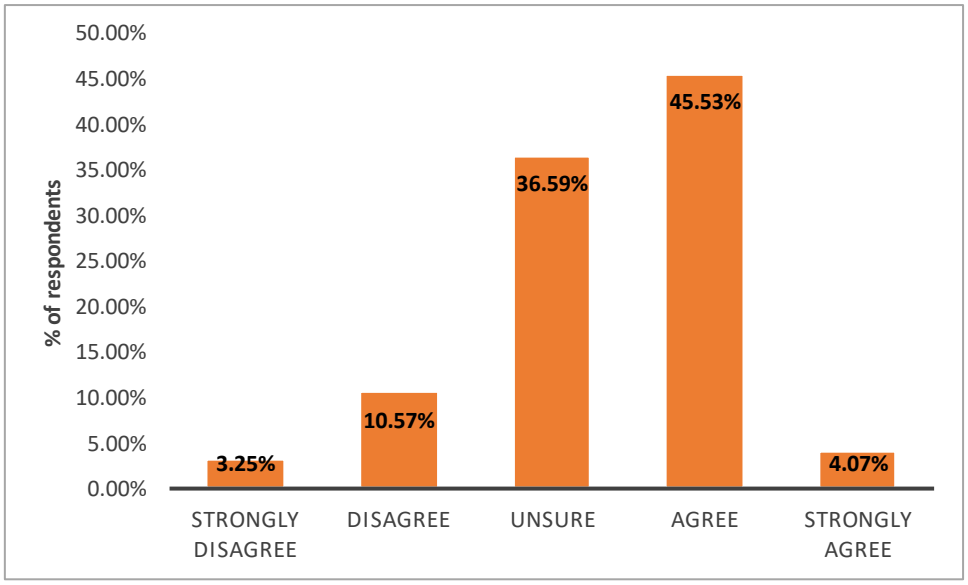

Fig. 21. Perception on the economic stability of Samar without mining.

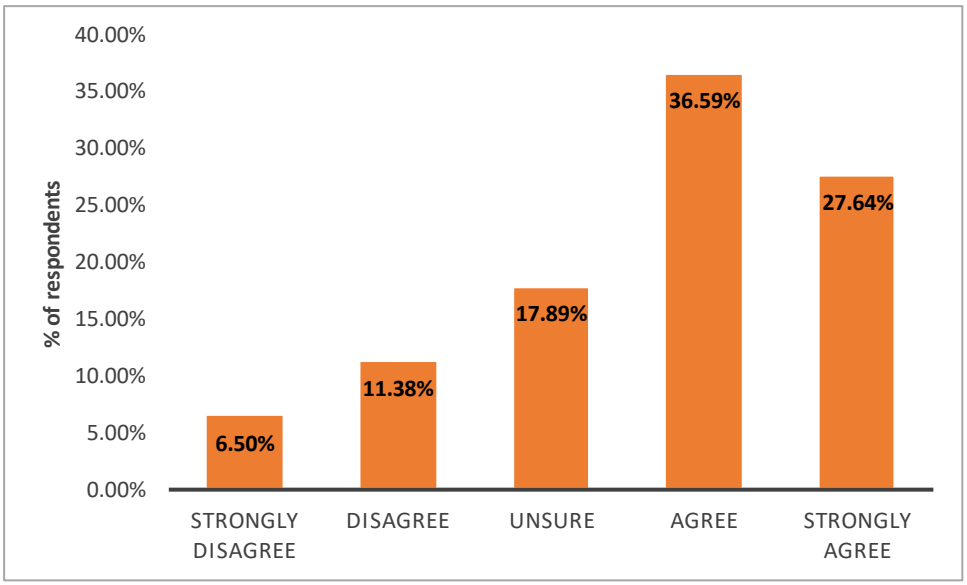

Fig. 22. Perception on the re-opening of the Bagacay Mine.

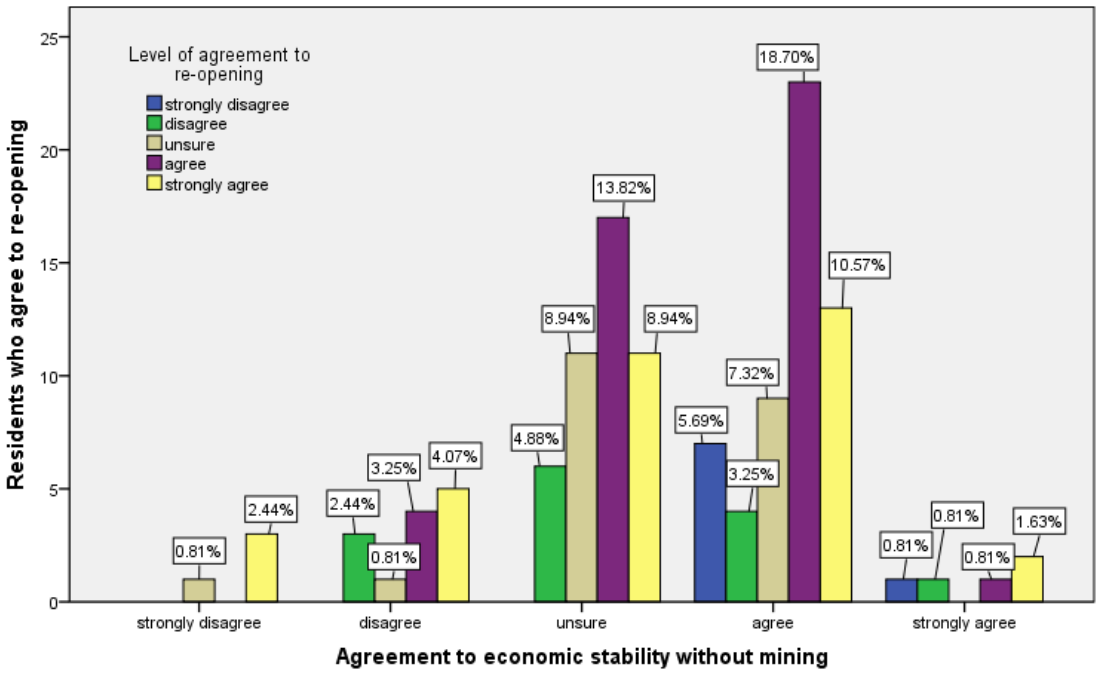

Fig. 23. Comparison between agreement to economic stability without mining and agreement to re-opening of the mine.

The issue on mine re-opening is a central theme during the survey, FGD and KIIs since it is anchored in every aspect of the rehabilitation. For instance, environmental issues like reforestation of the mined site still boil down to job security for the residents. Hence, several factors were examined to identify their relationships to the respondents' agreement to mine re-opening. These determinants are age, gender, awareness of the rehabilitation program, education, household income, years of residency, and former mine employment status. Out of these variables, only the years of residency (**Table 9**) and former mine employment status (**Table 10**) are correlated with the agreement to mine re-opening based on Spearman's rho analysis. The former has a significance value of 0.051 while the latter has 0.056, which means that the values are linked. The years of residency has a positive correlation with agreement to re-opening ($\rho = 0.176$). **Fig. 24** shows that as the year of residency increases, the agreement to mine re-opening also intensifies. In **Fig. 25**, it is illustrated that former mine employees or those who are related to former mine employees agree to the re-opening compared to those who were not formerly employed, which demonstrates a negative correlation ($\rho = -0.173$). This is reasonable, since they were the ones who have benefitted from mining based on first-hand experiences. Regardless of age, gender, awareness, education, and household

income, the residents agree with the re-opening of the mine. This is because the people of Bagacay have known mining as the only source of income since they inhabited the area. And that is their very reason of moving into Bagacay in the first place.

Table 9. Correlation of years of residency with agreement to re-opening.

			Years of residency	Agreement
Spearman's rho	Years of residency	Correlation Coefficient	1.000	.176
		Sig. (2-tailed)	.	.051
		N	123	123
	Agreement	Correlation Coefficient	.176	1.000
		Sig. (2-tailed)	.051	.
		N	123	123

Table 10. Correlation of former mine employment status with agreement to re-opening.

			employee	S5Q30_reopen
Spearman's rho	employee	Correlation Coefficient	1.000	-.173
		Sig. (2-tailed)	.	.056
		N	123	123
	S5Q30_reopen	Correlation Coefficient	-.173	1.000
		Sig. (2-tailed)	.056	.
		N	123	123

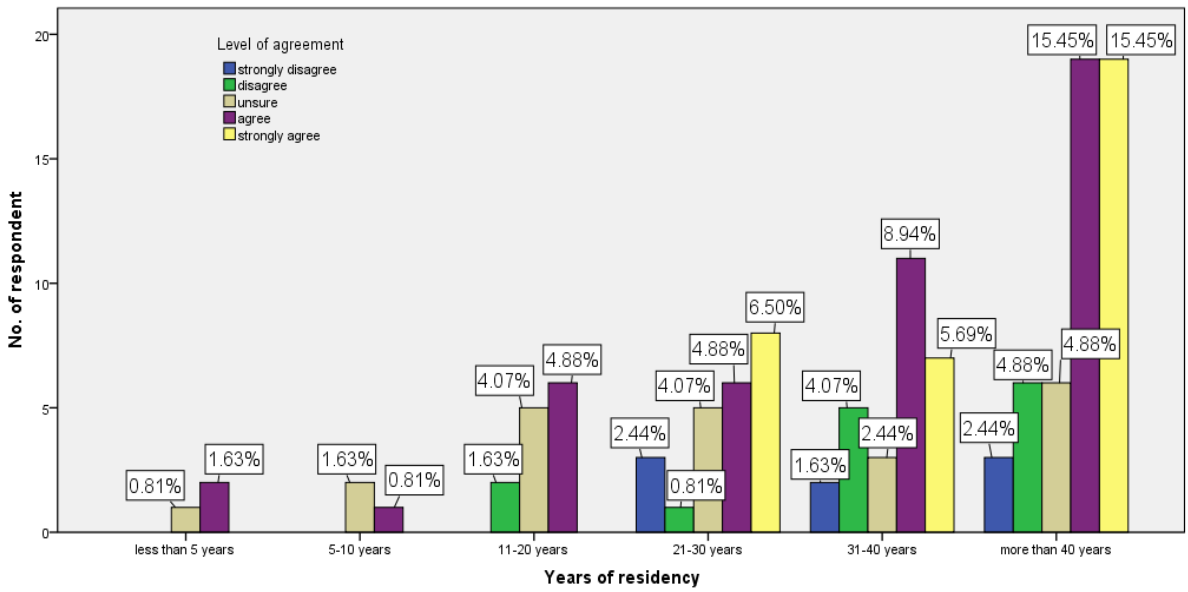

Fig. 24. Years of residency vs. agreement to re-opening.

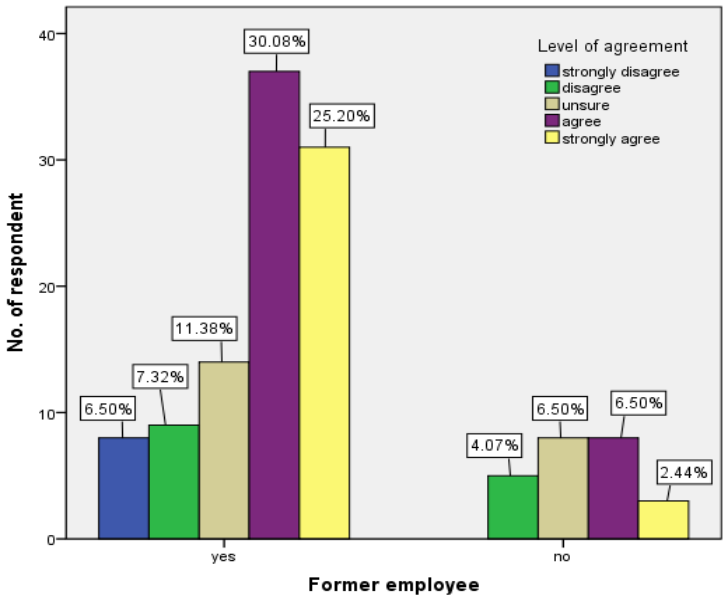

Fig. 25. Former mine employment status vs. agreement to mine re-opening.

However, the residents along Taft River have a very strong opposing opinions about the re-opening of the mine. Community leaders recount the effects of mining in their area. Since they are situated along Taft River where the mine tailings were directly discarded, they were the most adversely affected. They stated that even after the mining had shut down, the pollution and siltation of Taft River continued. Their crops withered and the fish died. As a result, their livelihood was affected. When asked about the possibility of re-opening the mine, all of the key informants were strongly against it. They said that the negative effects still outweigh the benefits of mining in Bagacay. To quote, *"We are strongly against the re-opening of the mine because we are the ones who were severely affected during the mining operations.*[27]*"* This aversion to mining due to catastrophic experiences in the past has implications on environmental justice issues which is particularly discussed in **Section 5.1**.

Results of the socio-economic perception of the rehabilitation underscores that despite the residents' awareness of the environmental component of the rehabilitation, they still want to re-open the mine due to the lack of livelihood in the area.

[27] Based on the interview conducted with community leaders of Brgys. Malinao, San Pablo, Mabuhay, and Gayam on Oct. 25, 2017. All of the interviewees were directly visited at their homes because no communication letters were sent to them beforehand due to the lack of telecommunication signal in those areas.

4.2.6 Perception on the importance of rehabilitation components

Respondents were asked to rank the rehabilitation components in order of increasing importance to them (1 being the most important and 4 being the least important). These are the environmental, public safety, public health, and socio-economic components of rehabilitation. **Fig. 26** shows that among these components, socio-economic is perceived to be the most important (41 out of 123 respondents or 33.33% ranked it as first). This is followed by the public health component (36.59% ranked it as second). Public safety was ranked third by 34.15% of the respondents, while environmental component is the least important (ranked last by 34.15% of the respondents).

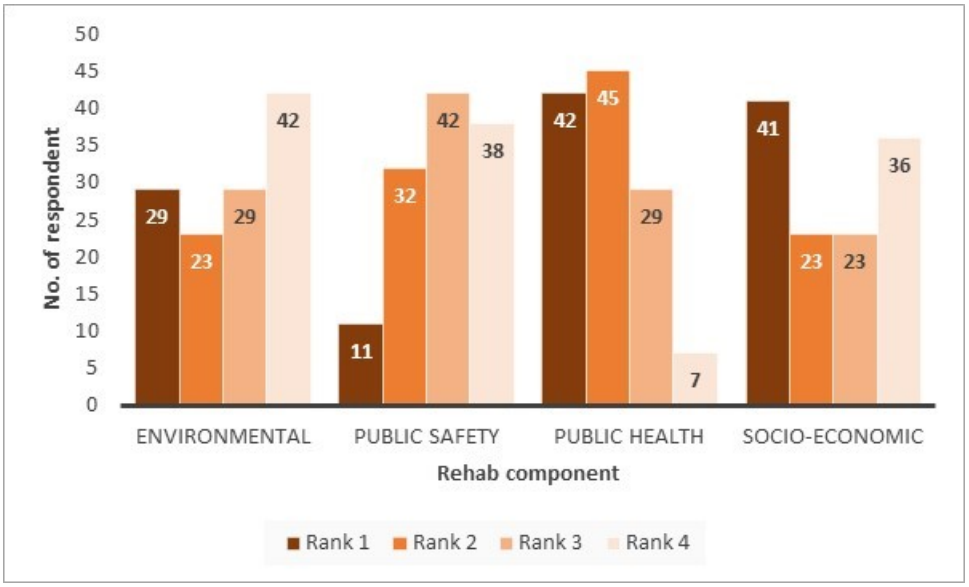

Fig. 26. Ranking of rehabilitation components (n=123).

4.2.7 Overall remarks regarding the rehabilitation

Respondents were asked in the questionnaire survey about their overall comments about the rehabilitation. Some residents view it positively, while majority have negative remarks. Some of the positive observations include the improvement in the rehabilitation in the mined-out area. A few said that they are contented with the rehabilitation efforts and hope that there will be a continuous rehabilitation until the aesthetic value of the surroundings of Bagacay Mine comes back. One respondent

stated that the most important aspect of rehabilitation is that of the economy so that residents near the mining site will be able to secure jobs.

On the other hand, majority of the respondents are not convinced with the rehabilitation efforts of the government. According to them, there is a lack of implementation of the project and that the government should improve the rehabilitation even more, up to the last affected barangay. Others stated that the remaining minerals must be extracted first before planting trees in the mined-out area because plants don't grow as long as there are minerals in the soil. Others expressed their disagreement with the rehabilitation program because according to them, they cannot see any "evidence". This is because they are not allowed to enter the former mine site unless they secure a permit from the PMO. Furthermore, most of those who are not convinced with the rehabilitation program have such opinions rooted in economic aspect. According to them, they are not satisfied with the rehabilitation because not all locals were provided jobs by the DENR. Some also believe that there are illegal small-scale mining activities happening in the former mine site which they call *"camote mining"*. Because of this, most of the respondents are convinced that the mine should be formally opened because there is corruption in illegal mining and that only a few benefits from Bagacay Mine. Moreover, their main concern is job security ─ either from being employed in the tree planting in the mined-out site or in the re-opening of the mine.

In essence, the residents are hoping for mine re-opening mainly to augment their livelihood. However, the community can be described as passive since they are not performing any motion to convince the government to re-open the Bagacay Mine. It is therefore clear that their primary concern is their source of income and not the re-opening of the mine *per se*. The passiveness of the community could be a good venue to introduce other activities that can both bring them profit aside from mining and promote biodiversity conservation. This will be discussed in detail in **Section 7.4**.

4.2.8. Community imageries of a successful rehabilitation

The FGD participants were asked to enumerate their mental images of a successful rehabilitation. At first, they were hesitant and just said, *"We don't know. We can't even*

enter the area." But after explaining to them that they just need to write down the scenarios in which they will agree that the rehabilitation program is successful, they have identified the components of a successful rehabilitation. Components were categorized into the following: environmental, public safety/public health and socio-economic. Health and safety were grouped as one category since they are closely related and imply the same idea based on the respondents' inputs. Some answers overlap into two categories. Outputs from both male and female FGDs were combined and illustrated in **Fig. 27.**

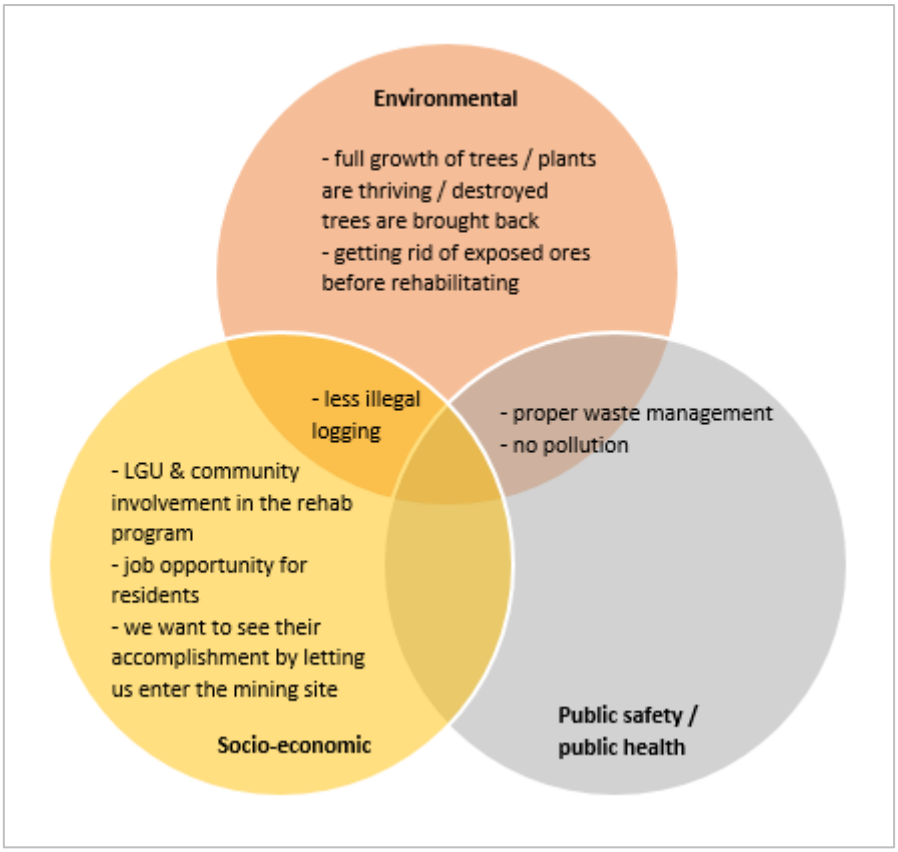

Fig. 27. Imageries of a successful rehabilitation based on FGD results.

Environmental components consist of the growth of trees as a parameter for a successful rehabilitation. Participants perceive a program to be effective if plants were able to thrive in the abandoned mine land. In connection with this, they believe that the plants will grow faster if the exposed ores will be removed first, as heavy metals in the soil impede their propagation. Proper waste management from the mine tailings wherein the river is not affected and pollution is eradicated overlap the environmental and public

safety/health components. The socio-economic component is composed of LGU and community involvement. According to the participants, they want to know the accomplishments of the government as well as contribute to the rehabilitation program by giving them permission to enter the mined-out site. They also see job security as a success indicator wherein residents are provided employment through tree planting in the area. This is related to the decrease in illegal logging as a measure of effectivity which encompasses both the environmental and socio-economic components. This is because when people have a source of livelihood, they will not see the forest as a means for income generation.

5. SUMMARY AND CONCLUSIONS

The purpose of this mixed methods study was to evaluate the rehabilitation measures in the former Bagacay Mine through quantitative and qualitative methods. Data from the interviews with government representatives and field survey were analyzed to identify the gaps between the public perception of the rehabilitation efforts and the actual rehabilitation process. The quantitative survey employed basic descriptive statistics in analyzing and interpreting the public perception on the rehabilitation of the former Bagacay Mine, while KIIs and FGDs were conducted in order to interpret and triangulate the results of the survey through content analysis method.

Research questions and assumptions were discussed along with the presentation of results. To answer research questions 1, 2, 3, and 5, content analysis of the interviews with government representatives was done. It was found out that there is no legal definition of abandoned mines in the Philippines and therefore the lone criteria for declaring a mine site abandoned is when no one owns it anymore. In terms of the rehabilitation of the Bagacay Mine, phytoremediation and soil amelioration methods were used in order to increase the vegetation growth. The plants were chosen based on their capacity to absorb and store heavy metals from the soil. Similarly, the optimal soil amelioration method was determined through a series of trials on the most effective soil formula in terms of plant growth. However, no concrete criteria for successful rehabilitation was established yet. At present, the basis for determining the success of rehabilitation is mostly based on the plant growth and soil and water pH levels. Hence, only the environmental and public safety components are considered. These findings therefore support the first assumption that there is a need to include the rehabilitation of all components in the Bagacay Mine rehabilitation program.

Research question 4 was answered through the conduct of field survey which includes questionnaire survey, FGDs, and KIIs. Descriptive analysis through IBM SPSS Statistics 20 and Microsoft Excel 2016 were done to be able to determine the public perception on environmental, public health and safety, and socio-economic impacts of mining and rehabilitation. Results from the perception on environmental impacts stated that there is a significant number of respondents from Brgy. Bagacay who are unsure

about the environmental impacts of the rehabilitation program. This can be attributed to the fact that the site is not open to the public. Hence, the residents are unable to see if there is any progress in the rehabilitation. The same is true with the residents of the communities along Taft River. Most of them are not aware of the rehabilitation in Bagacay Mine. As to health and safety issues, respondents from both Brgy. Bagacay and barangays along Taft River have not stated any incident of poisoning from toxic metals, skin problems, or any human health issues. Results from perceptions on socio-economic impacts show that although respondents from Brgy. Bagacay agree that Samar's economy can be stable even without mining, majority believe that the mine should be re-opened. This is further supported by the results from FGDs wherein the participants stressed out the importance of mining as a source of their livelihood.

Research question 5 was explained by the results of interviews with representatives of all the government agencies involved in the rehabilitation program, including the regional offices in Western Samar (Region VIII). It was found out that the either the former mine site or the remaining minerals which will be re-mined will be sold by the PMO in the future, although the office did not confirm it during the interview. This therefore rejects the second assumption that the future land use plan for the former Bagacay Mine does not consider the re-opening of the mine since it is within the borders of SINP. In relation to the issue of re-opening, which is the central theme during the survey, FGD and KIIs, the respondents from Brgy. Bagacay and communities along Taft River have very different views on the impacts of mining in Bagacay Mine. While residents of Brgy. Bagacay are inclined to the benefits brought about by the mining industry, those from communities along Taft River rehashed the adverse environmental effects of the industry, which in turn, affected their livelihood. The presence of mining industry means livelihood to the former, while the absence of it means the same to the latter.

The last assumption that the local government, organizations, and community are involved in the rehabilitation and decision-making was dismissed by the results of both the field survey and interviews with government representatives. Both the MGB and ERDB stated that only the PMO has the mandate to decide for the former Bagacay Mine. The involvement of both bureaus is limited to the technical aspects of

rehabilitation. Moreover, the Hinabangan town mayor stated that the LGU and community are not involved in any aspect of the rehabilitation program, much less on the decision-making process. Similarly, the SINP PASu said that their office is not consulted when carrying out decisions for the mined site. This depicts the incoherence of government agencies regarding the implementation of the rehabilitation program. The project is executed in accordance with the objectives of the MGB and ERDB which, based on the interviews with their representatives, appear to be unrecognized by the PMO since there are difficulties in obtaining a permit to enter the area. Other government and non-government agencies which certainly can provide environmental, social, public health and safety expertise are currently not involved in the rehabilitation project.

In conclusion, AML rehabilitation is a relatively new concept for developing countries such as the Philippines. Successful rehabilitation programs have been undertaken in developed nations such as the United States, Canada, and Australia; and developing countries can learn from their best practices. The Philippines has a long way to go in terms of strong governance that is willing to take accountability of the legacy mines left by the lack of firm legislations in the past. In the case of Bagacay, the rehabilitation effort is still in its early stages and needs further improvement. The ERDB and MGB have shown serious commitment on their attempt to rehabilitate the former mine, but "a sincere desire to completely rid the earth of all related hazards and risks is not enough (Brehaut, 2008)." A strategic rehabilitation framework which encompasses all the rehabilitation components must be established.

Presently, rehabilitation efforts are not yet sufficient to completely resolve the interconnected issues of environment, public health and safety, and socio-economic conditions. The environmental rehabilitation is still focused on the reforestation of the mined-out site and less on the siltation of the Taft River and biodiversity restoration. Consequently, Brgy. Bagacay becomes easily flooded and trapped during heavy rains and typhoons when the river overflows, and therefore risking public safety. Severe flooding in the communities along Taft River causes loss of their livelihood because of increased rates of fish deaths and destruction of their crops along the river. This affects

the socio-economic status of the residents which the rehabilitation program has not addressed yet.

Also, the current stakeholder framework is non-inclusive of the community and experts from different government and non-government organizations, and there is a need to address this in order to uphold better knowledge exchange towards effective decision-making. This will be discussed thoroughly in **Section 7.1**. Above all, a strong political will of the government to rehabilitate AMLs is lacking in the case of Bagacay Mine. The PMO, which is the caretaker and decision-making body of the former mine site, is proven to be the major cause of delay of the progress of rehabilitation works in the area. While it is true that it is not their mandate to rehabilitate the area, they should fully cooperate with the ERDB and the MGB who are executing the rehabilitation measures in the area. The national government absolutely needs to embolden synergy and collaboration among concerned government agencies towards a successful rehabilitation program.

5.1 Implications on environmental justice issues in mine-affected areas

The advent of environmental justice concept and social movements started in the United States in the wake of unequal distribution of detrimental environmental impacts in the community wherein the most affected are the people of color. This was the incident in 1982 in Warren County, Northern Carolina where there is the highest proportion of African Americans that was being dumped with soil contaminated with polychlorinated biphenyls (PCBs). Environmental justice scholars and activists believe this to be the onset of environmental justice movements. This is also variously known as environmental inequality, environmental injustice, or environmental racism Mohai, Pellow, and Roberts, 2009). The construct of environmental justice is rooted from "actual experiences and events that negatively affect individuals and their communities" (White, 2013). Its main focus is on the unfair distribution of benefits and burdens and their allocations among different groups within the society. (Salzman and Thompson, Jr., 2007 as cited in Legaspi et al., 2011). Unequitable benefit and burden distribution occurred during the mining operations in Bagacay. While the residents of Brgy. Bagacay were relishing the profits from mining, the communities along Taft

River were bearing the consequences. However, as with any other development project, it was not all benefits to the host community. There were direct and indirect effects of the abandoned mine in the immediate vicinity and communities nearby. It directly affects the people living along the Taft River by the pollution caused by the acid mine drainage in the river. In effect, the residents lost their livelihood following the death of their crops and fish kills. On the other hand, while the residents of Brgy. Bagacay were not directly affected by the mine abandonment, indirect environmental effects were experienced, in which, the most apparent is illegal logging. Some residents saw the forest as a new source of livelihood when the mine operations shut down. According to the FGD, this has caused them severe floodings particularly during strong rains and typhoons. Presently, both communities are not involved in the rehabilitation program of the government. This is seen as a problem as discussed in several sections in the results. Using the lens of environmental justice, stakeholder involvement, particularly the affected communities is imperative (White, 2013). There must be a close coordination among stakeholders when it comes to resolving problems of toxicity in order to widen the range of expertise taking part in the program and consider the ecological and social perspectives of rehabilitation. An extended stakeholder map is recommended which is discussed in **section 7.3**.

6. LIMITATIONS OF THE STUDY

One study limitation was the language barrier. *Waray*, which is the local language in Western Samar is one of the eight major languages in the Philippines. Survey questions were written both in English and *Waray* but discussions were conducted in the local language. Similarly, FGDs and KIIs were initially administered in *Tagalog*, the researcher's local language, but as the discussions were progressing, it became inevitable for the participants to speak in *Waray*. The help of research assistants in translating the responses made it convenient for the researching to understand what they are trying to convey. However, some responses might have been unavoidably lost in translation and therefore interpreted differently from what was intended by the participant.

Another limitation is that the FGD participant selection relied heavily on the advice of the community leader after the researcher set the criteria for choosing the participants. The group might be biased to a particular faction, as described by the ERDB representative. The FGD participants might not accurately represent the whole population. For example, the participants stated that there were no community consultations, but the ERDB claimed otherwise. The latter said that the FGD participants that the researcher had gathered might had not included the residents who participated in the community consultations. However, the possibility of unfavorable effects of this limitation was curtailed by cross-referencing the FGD outcomes with the questionnaire survey results.

Lastly, the restriction of the PMO to the access site indirectly affected the quality of data gathered. Since the residents and other stakeholders are denied entrance to the rehabilitation site unless they have a permit, it had an effect to the way the participants responded to the survey questions and discussions. For instance, when asked about their idea of components of a successful rehabilitation, there was an initial hesitation to provide answers because they do not have a clear picture of the actual rehabilitation project of the government. Nevertheless, this limitation was accounted in the administrative implications of the program.

7. RECOMMENDATIONS

Based on the results of the study, recommendations regarding administrative and mandate issues, the scope of rehabilitation program, livelihood programs, and awareness and policy strengthening were formulated.

7.1 Administrative, legislative, and mandate issues

Administrative issues were identified as the major cause of project delay based on the interviews with government agencies involved, official document reviews, and field survey. The PMO and the MGB should clarify their Memorandum of Agreement on the rehabilitation of the Bagacay Mine because its complexity leads to interruptions on the execution of project objectives, at the same time affecting the budget timeline and allocation.

There are also mandate overlaps in the conduct of rehabilitation. For instance, the establishment of parameters for pollution control is the role of EMB according to the MGB representative. However, in the reports submitted by the MGB and ERDB, there was no mention of EMB conducting pollution control measures. Furthermore, a lack of substantial criteria for monitoring is apparent. In this regard, it is recommended that the DENR clarifies the mandate of the bureaus that should be involved in the rehabilitation program towards an efficient monitoring system.

The stakeholder circle is also currently narrowed-down to a few government agencies and excludes the LGU and community. The rehabilitation progress yields results that are visible only to the immediate vicinity which is Brgy. Bagacay. Hence, there is a need to broaden the stakeholder map and include other concerned national and local government agencies, people's organizations (POs), non-government organizations (NGOs), subject matter experts (SMEs), the mining industry, and communities in the rehabilitation program. The Biodiversity Management Bureau (BMB) was added to the stakeholder map since it deals with biodiversity restoration. The Department of Tourism (DOT) will evaluate the workability of converting the area into an ecotourism destination. According to the national coordinator of Alyansa Tigil Mina, *"Monitoring*

teams should include scientists and engineers with background in the industry, agriculturists, water experts, concerned PLGUs and communities who depend on portions of AMLs for their livelihoods." There should be consultations involving the said organizations to be able to broaden the scope of rehabilitation and strengthen the decision-making process for the former Bagacay Mine. This group of stakeholders can make up the Abandoned Mine Lands (AML) Advisory Committee like in Canada. Local knowledge and expertise are significant in the rehabilitation process. This will also ensure a smooth turnover to the LGU and community at the conclusion of the project. This will promote the continuity of rehabilitation even after the government program is completed. **Fig. 28** illustrates the suggested AML Advisory Committee for the rehabilitation program.

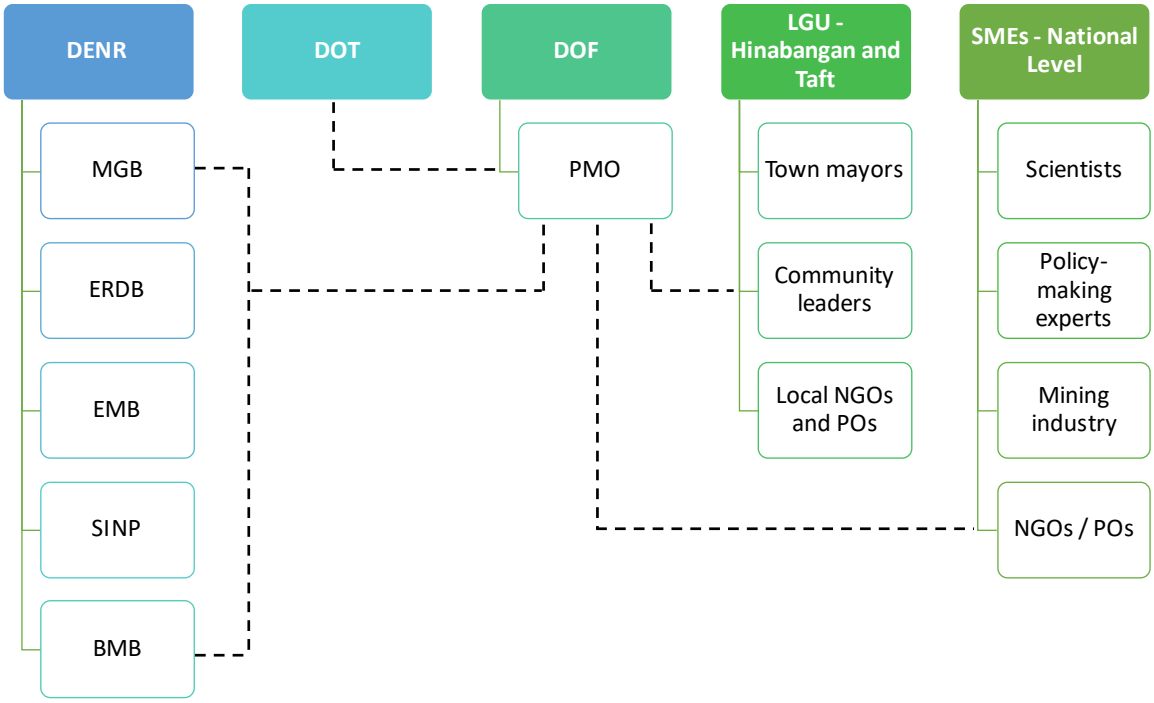

Fig. 28. AML Advisory Committee recommended for the Bagacay Mine rehabilitation program.

With regards to the PMO mandate as the administrative leg of the Bagacay Mine, their policy on the strict issuance of gate pass should be reexamined. This stringency was proven unhelpful, worse, a hindrance to the success of rehabilitation. Therefore, they should observe a smooth process of gate pass issuance to the MGB, ERDB and other

stakeholders that will be involved in the future so that they will be able to execute their project objectives on time.

Regarding legislation, it is recommended that the declaration of SINP be passed into a Republic Act under the NIPAS Act of 1992 in order to legally protect the area from extractive activities in the future. This would facilitate the circumvention of further environmental damages.

7.2 Extending the scope of rehabilitation

Results showed that the rehabilitation program of the government is currently focused on the environmental and public safety components although socio-economic aspects are also reflected in their project objectives. It is recommended that the latter be implemented. Interview results with the regional and national MGB showed that there was a plan to construct a diversion pipe channel that will bring potable water to the community. However, it was discontinued due to administrative reasons. The researcher recommends the bureau to revisit this component and continue its construction because it will be of great help to the community if there will be an additional source of clean water in the area. Currently, the residents are obtaining their drinking water from different sources such as creeks. Additionally, the transformation of the rehabilitated site into an ecotourism destination for both local visitors and foreign tourists, which is included in the project objective, will bring increased revenues to Hinabangan and Bagacay and will help the residents to secure jobs.

7.3 Formulating a concrete full rehabilitation plan

Since the Bagacay Mine rehabilitation program is mostly focused on the environmental component (e.g., site revegetation), a full rehabilitation plan must be formulated. **Fig. 29** summarizes the proposed rehabilitation scheme. The first and most important step should be the consultation with the newly formed AML Advisory Committee, as discussed in Section **7.1**. The committee must have a consensus regarding the rehabilitation plan which includes the specific success indicators of the program. At this stage, stakeholder engagement is crucial in setting and agreeing with the parameters

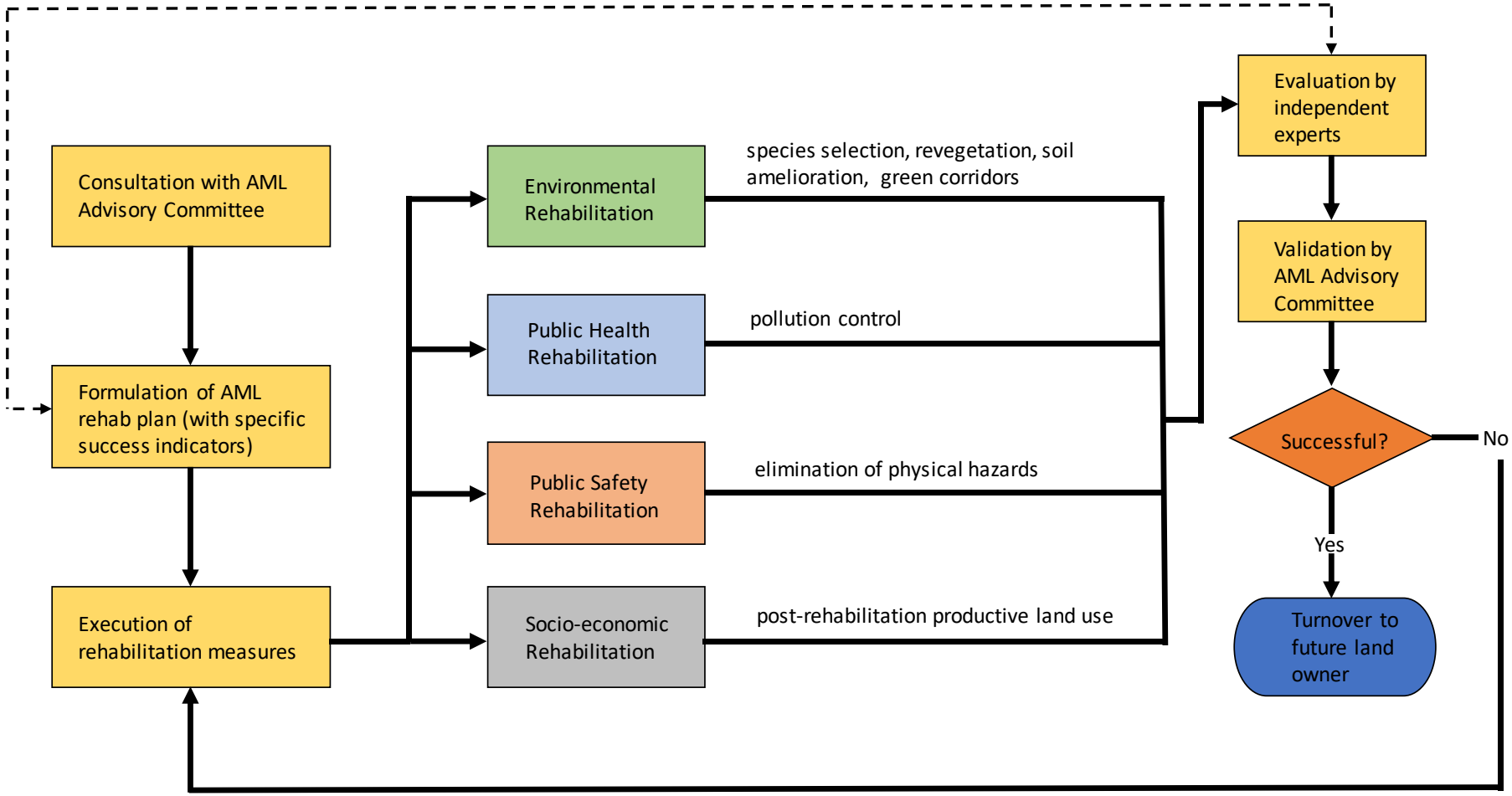

Fig. 29. Diagram of the proposed full rehabilitation plan.

for decision-making (Limpitlaw and Briel, 2014). Once the rehabilitation plan has been finalized, the MGB should render the rehabilitation measures for each component. Environmental rehabilitation should consider not only the revegetation of the site but also the restoration of faunal biodiversity through construction of green corridors that will facilitate movement of animals. The public health aspect should include pollution control and eradication of toxic wastes, particularly the acid mine drainage towards Taft River. To ensure public safety, physical hazards should be eliminated through measures such as anti-erosion and landscape restoration. Finally, the AML should be assigned a productive post-rehabilitation land use which can generate revenue and employment opportunities for the community. It can be converted into an ecotourism site, which is included in the objectives of the Bagacay Mine rehabilitation program that is yet to be realized. After all components have been rehabilitated, it should be evaluated by independent experts against the parameters set by the AML Advisory committee to ensure that they were accurate and to avoid bias. This will be different from the current procedure wherein the MGB and ERDB evaluate the outcome of their own rehabilitation methods. The evaluation of independent experts should be further validated by the AML Advisory Committee. In the event that the committee decided that the rehabilitation is unsuccessful, the rehabilitation measures will be reexamined and components that were not properly rehabilitated will be reinforced. No land handover should be made when risks are still not mitigated to acceptable levels (Limpitlaw and Briel, 2014). Once the rehabilitation is confirmed successful, the land will be turned over to the new owner. In the case of Bagacay Mine, since it is under the custody of the PMO, it is safe to assume that the land will be sold to private individuals or companies.

7.4 Additional livelihood programs and biodiversity conservation

There should be livelihood training programs so that the residents can learn about possible income source other than mining and forest products collection. This is important especially that the NIPAS Act of 1992 states that extractive activities are not allowed within a protected area. Hence, even though the residents of Brgy. Bagacay are strongly in favor of mine re-opening, there is a great possibility that it will not push through. Also, the MGB representative said in the interview that in line with the NIPAS

Act, they will not approve mining applications in the future should there be any, since they are the agency responsible for the screening and approval of applications. According to SINP PASu, the DENR has various livelihood programs for the community. One of these is the National Greening Program (NGP) which aims to plant 1.5 billion seedlings in 1.5 million hectares of public lands nationwide. Residents earn from being employed by the DENR to plant the seedlings for the project. But despite this, the LGU must provide additional income-generating activities for the residents[28] since based on the survey results, majority of the respondents are earning below Php5,000 every month for an average household size of four. There were no visible government livelihood projects in the area. This is validated by the FGD wherein the participants stated that indeed, there are no programs in the area to supplement the income of the residents. Similarly, the residents along Taft River should be given compensation in the form of livelihood programs for the damages that they have suffered due to the acid mine drainage caused by the previous mining operations.

Although the residents are strongly in favor of the mine re-opening, they have a passive attitude towards it. There were no actions executed by the community to persuade the government to do so. This passiveness could be an excellent platform to shift their focus to other activities that can bring them revenue and other benefits through biodiversity conservation. For instance, the discontinuation of illegal logging and charcoal making will slow down the rate of deforestation which will result in reduced flood risks. Therefore, their livelihood (e.g., crops and livestock, if any) will not be at stake. The economic activities in the community such as the passage of goods cargoes from other *barangays*, as mentioned in the FGD, will also not be impeded. Moreover, if enough attention is bestowed upon biodiversity conservation, it can potentially pave the way towards additional source of livelihood for the community. Robust ecosystems attract a variety of life forms. When forests are healthy, it can be home to various species of birds and other organisms. In the long run, the area can be a prospective birdwatching spot for tourists. And since Bagacay is already within the natural park borders, the SINP

[28] Based on the interview with the SINP PASu Zenaida Baisa conducted on Oct. 26, 2017 at the SINP office in Brgy. Tenani, Paranas, Samar. This is the same area where the research team stayed for the rest of the field survey conduct.

office can capacitate the community on how to manage the site and gain revenues from it while maintaining the ecosystem balance.

7.5 Awareness and policy strengthening

There is a need to strengthen the awareness on the rehabilitation program since the results of field survey reflect that there are low awareness levels in the primary site. In the secondary sites, nobody is aware of the program based on KIIs. There should be IECs regarding the rehabilitation program in order to educate the public on the importance of AML rehabilitation and how they can contribute to the success of the project. This is also to avoid confusion with other environmental projects of the government. Increased awareness of the importance of rehabilitation will lead to more informed decisions of the community and LGU in terms of environmental management. In addition, strict policy measures on the extraction of natural resources should be reinforced since there were reported cases of illegal logging and *camote mining* in Brgy. Bagacay. According to MGB-VIII representative, they need assistance from the Criminal Investigation and Detection Group (CIDG) of the Philippine National Police (PNP) in order to apprehend offenders. A close coordination between legal authorities and DENR is necessary in order to lessen if not eradicate the cases of illegal environmental activities in the area.

7.6 The Responsible Care concept in AML rehabilitation

The Responsible Care Program (RCP) is a set of voluntary codes pioneered by the Chemical Manufacturers Association of western countries. It originated in Canada in 1985 and in the United States in 1988 (Prakash, 2000). It was developed following the Bhopal disaster wherein a methyl isocyanate, a toxic chemical, spilled from a Union Carbide plant in India in 1984 killing approximately 5,800 to more than 20,000 people (Kumar, 2004; Purvis and Bauler, 2004; Johnson and DeRosa, 1997 as cited in Givel, 2007). The goal of the RCP is constant progress in the performance of member companies regarding the environment, health, and safety that should meet public expectations (CMA, 1993a as cited in King and Lenox, 2000) and therefore requires peer evaluation by other companies who follow the same program to ensure that

standards are met (Prakash, 2000). The development and promotion of RCP was also included in Agenda 21 (United Nations, 1992).

Based on a study by Anton et al. (2004), the most important stakeholder groups which motivate chemical companies to espouse RCP are consumers, investors, and the public (Evangelinos, Nikolaou, and Karagiannis, 2010). While the program is originally designed by chemical companies for chemical companies, the mining industry can adopt the RCP for the same reason which is the improvement of their environment, health, and safety (EHS) measures in response to stakeholder demands. With regards to the rehabilitation of abandoned mines, three of the six RCP codes of conduct can be implemented: (1) Community Awareness and Emergency Response, (2) Pollution Prevention, and (3) Employee Health and Safety. The responsible body for AMLs, which is now the government, must ensure that the community is aware of the rehabilitation works in the area in terms of environmental, health, and safety issues. There must also be an emergency response in place in case unlikely events (e.g., natural disasters) occur. Waste management practices in AMLs should be exercised as well. In Bagacay, where acid mine drainage caused by heavy metals is evident, documentation and monitoring on waste generation should be made in order to evaluate potential EHS impacts and minimize pollution in the long run. The health and safety of government employees who are working on the rehabilitation of AMLs must likewise be considered. In the case of Bagacay Mine, safety is a major concern since the old mining infrastructures like the waste dump are already frail and therefore precautions are needed. The government needs to ensure that the hazards in the site will not lead to unforeseen accidents.

The above-mentioned RCP codes of conduct can also be applied to the rehabilitation of mined sites of current mining operations. There should be dialogues with the community in order to promote awareness of the program. Emergency response measures should also be in place in case of disaster. In areas where toxic chemicals are discharged (e.g., mercury), proper pollution control should be implemented. Moreover, the health and safety of employees and the community should be promoted. Mining companies should design programs that ensure the health and safety of its employees during mine rehabilitation. In most cases, employees are members of the local

community. And since mining operations are usually simultaneously done with rehabilitation works, the host community should also be protected from all types of hazard in the area.

7.7 Program replication in other AMLs in the Philippines

The success of the rehabilitation program of the government cannot be measured presently due to the lack of concrete parameters. However, it is a fact that the species that they have planted in the former mine site are thriving in spite of unfavorable environmental conditions. As stated in the 2016 unofficial progress report of the ERDB and MGB,

"This experience tells us that rehabilitation of mined-out areas really takes time and very expensive as mining activities totally destroyed the above and below ground properties of the site. But with serious commitment and application of science-based technology, even the most damaged environment can still be restored."

Taking this into account, it can be said that the rehabilitation methods employed in the Bagacay Mine can possibly be replicated in other AMLs in the country, but with several factors to consider. First, concrete monitoring criteria and parameters must be established at the beginning of the project. There must be specific success indicators in place in order to assess the rehabilitation outcomes. Socio-economic component must also be considered at the onset of the rehabilitation program to ensure the continuity of beneficial results even after the project has been concluded. This will raise the environmental awareness of the community that will help them make well-educated decisions in the future. Likewise, the final land use plan should be identified for a productive post-rehabilitation utilization that will contribute to the economy of the area and possibly secure jobs for the local people.

Second, concerned agencies and organizations must closely cooperate and the roles of stakeholders must be clearly defined. In the case of the Bagacay rehabilitation program, confusion in tasks led to the delay of project deliverables. If the same project will be replicated in other sites, it will be more efficient if local stakeholders will be included

in the AML Advisory Committee. Stakeholders must be thoroughly briefed of the whole project proposal ─ from objectives to expected outcomes and their functions and duties in the rehabilitation program. In this way, the sense of accountability will increase and progress monitoring will improve.

For a strategic rehabilitation of the rest of AMLs in the Philippines, the creation of National AML Advisory Committee is highly recommended (**Fig. 30**). This should connect the currently incoherent government and non-government agencies which can provide expertise in the implementation of the rehabilitation program. The committee can possibly be spearheaded by the DENR since the bulk of rehabilitation works consists of environmental restoration. Several bureaus of the DENR should work parallel to each other in order to resolve various environmental issues. These bureaus are the (1) MGB, who will still be responsible for the identification of priority AMLs for rehabilitation, as well as engineering and pollution control measures in AMLs, (2) ERDB for phytoremediation and reforestation researches, (3) EMB, for the establishment of success indicators that will be validated by the committee, and (4) BMB, who will be in charge of the biodiversity restoration in rehabilitated AMLs. BMB has its National Parks Division (NPD) which will assess the possibility of converting the rehabilitated areas into natural or national parks. The DOT will assess the feasibility of transforming it into an ecotourism site. The LGU should also be involved in the committee since local knowledge is indispensable in the implementation of rehabilitation projects. Similarly, the committee should include SMEs like scientists, policy-making experts, NGOs and POs, and the mining industry. Mining industries can provide experts/engineers since they also have their own rehabilitation programs as mandated by the Mining Act. These experts can share their best practices to the committee towards successful rehabilitation outcomes. With these members, the National AML Advisory Committee shall be responsible for the overall implementation and monitoring of the rehabilitation programs all over the country.

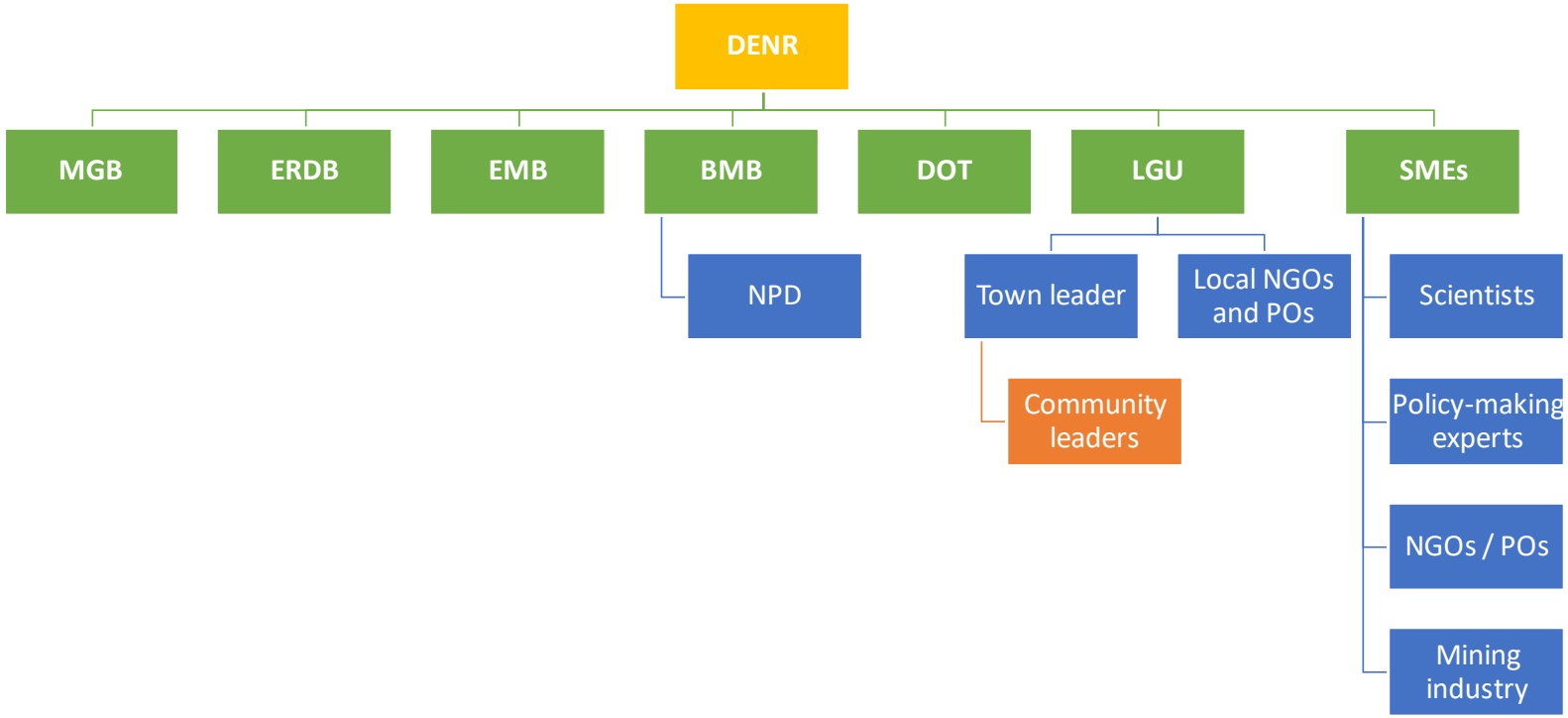

Fig. 30. Proposed structure of the National AML Advisory Committee.

Finally, the government can look into successful rehabilitation cases in other countries as well as, and particularly in the Philippines and study the possibility of applying the measures into the country's AMLs. The point is, if it can be successfully done by private mining companies, then there is a probability that it will also be effective in AMLs. Developing countries like the Philippines can adopt the strong political will and aggressive legal frameworks of developed nations when it comes to dealing with AML rehabilitation. For instance, a reduction of existing mining incentives can be implemented and redirected to AML rehabilitation. A portion of subsisting mine tax revenue can also be redirected to similar programs (Brehaut, 2008).

7.8. Co-designing watershed management among various stakeholders

The World Conservation Congress defines collaborative management, most commonly known as co-management, as "a partnership in which government agencies, local communities and resource users, non-governmental organizations and other stakeholders negotiate, as appropriate to each context, the authority and responsibility for the management of a specific area or set of resources (IUCN, 1996)". While the proposed AML Advisory Committee structures in **Fig. 28** for the Bagacay Mine rehabilitation program and in **Fig. 30** for the rehabilitation of AMLs in the Philippines, in general, might appear as a formal organizational hierarchy, the system should be designed as a co-management among the stakeholders, including the communities along the watershed. This will facilitate knowledge sharing among the committee members which will increase the likelihood of the project success. For instance, the local community and SMEs like NGOs and POs might need assistance such as the research and technology needed for the rehabilitation of the Bagacay Mine. In the same way, the implementing agencies will need the local knowledge of the community in carrying out the project objectives. Polymorphous knowledge types and sources from synergistic approaches are essential to problem-solving since governance is predisposed to ecological and social uncertainty (Armitage et al., 2009).

Carlsson and Berkes (2005) assert that the focus of co-managed systems should be on the organization and allocation of various management tasks rather than the system structure. **Fig. 31** illustrates the specific tasks which need to be accomplished in the

rehabilitation of Bagacay Mine and the proposed committee members who will be responsible for each activity. Here, the tasks represent the function of the system while the committee members embody its structure. In this representation, more emphasis is given to the rehabilitation measure than to the corresponding implementing agency.

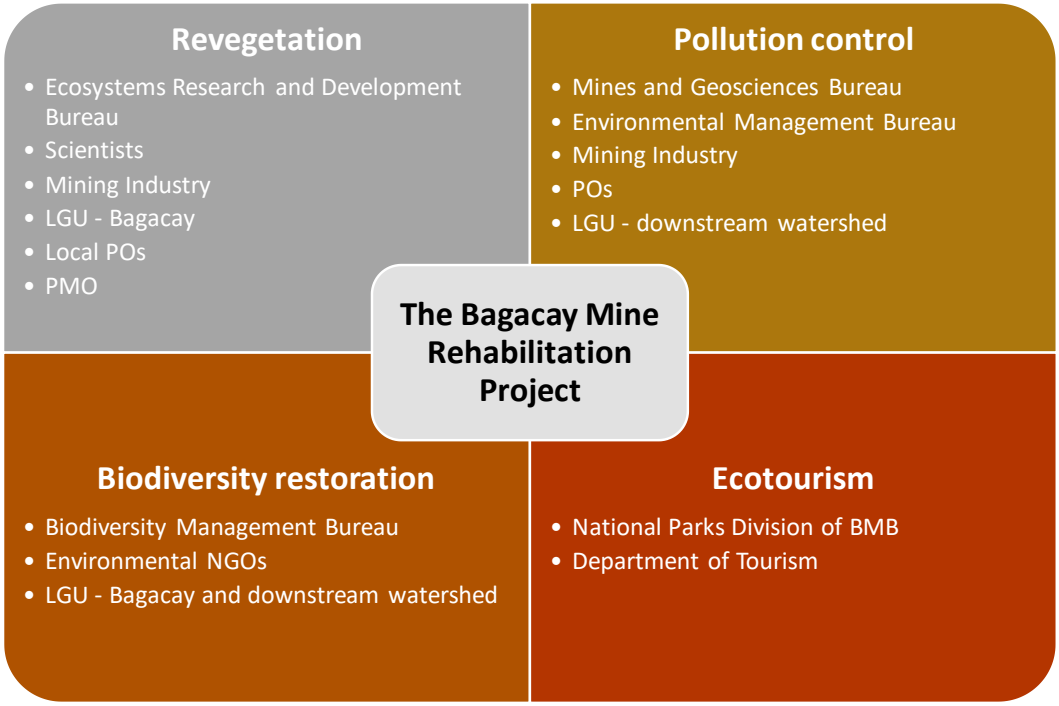

Fig. 31. Task matrix for the rehabilitation of Bagacay Mine and implementing agencies in a co-managed system.

In this design, the rehabilitation project is divided based on the major operations that shall be carried out. Each function is allocated to the stakeholders and is shared among them. For the revegetation, the responsibility is spread among the ERDB, scientists, mining industry, LGU, local POs and the PMO. The residents of Brgy. Bagacay will be the ones to manage the greenhouse and maintain the seedlings provided by the ERDB. It will also be their duty to plant them in the designated areas in Bagacay Mine together with the local POs and the PMO. The PMO currently does not have any role in the rehabilitation project. Hence, they are not aware of what is the actual state of the area. By involving them and sharing responsibilities with them, their awareness will increase which will probably aid in easing the tension between them and the MGB and ERDB. On the other hand, the research leg of the revegetation will be the scientists, the mining industry, and the ERDB (also the lead role for this function).

The pollution control measures will be a shared responsibility among the MGB, which will take the principal role for this objective, the EMB, the mining industry, POs, and the LGU. The MGB and the mining industry will be accountable for the construction of pollution prevention structures like dams and rock walls, while the EMB will be evaluating its effectivity based on the parameters agreed by the AML Advisory Committee. The role of the LGU and POs will be the regular monitoring of water quality based on the guidelines that will be provided by the EMB. Monitoring results shall be customarily reported to the EMB to track improvements or otherwise. The community in the downstream watershed was specifically assigned for the monitoring since the effluents are discharged towards the Taft River.

Biodiversity restoration will be led by the BMB in collaboration with environmental NGOs. This function is shared with the LGU of both Bagacay and Taft River communities. The LGU will be responsible for the monitoring of biodiversity in the area after capacity-building activities. Reports will be submitted to BMB on a regular basis in order to determine progress.

The final objective which is ecotourism will a shared responsibility between the NPD and the DOT. The former will be assessing the possibility of converting the area into a natural park, while the latter will be studying the feasibility of ecotourism in the rehabilitated site.

In this design, the activities, functions, and authority of stakeholders are subject to continuous re-adjustment to be able to adapt to socio-ecological changes (Carlsson and Berkes, 2005). The shared responsibilities stated above should not be treated as definite since activities might change depending on the socio-ecological conditions at the site. Since most of the functions require regular monitoring which will be performed by the community and POs, capacity-building activities will be a shared responsibility among the government agencies aside from the rehabilitation measures assigned to them. A strong monitoring system is vital to a successful common-pool resource management (Ostrom, 2012).

Appendix A. Actual questionnaire used during the field survey in Brgy. Bagacay, Hinabangan, Samar.

Questionnaire on the public perception of rehabilitation efforts in the former Bagacay Mine

Mga pakiana hiunong han paglantaw han publiko ha rehabilitasyon han minahan ha Bagacay

Section 1: Basic Information

Seksyon 1: Panguna na Impormasyon

1. Name (optional) Ngaran (Diri kinahanglan) _____

2. Age Edad ____

3. Gender Kasarian

□ **Male** Lalaki □ **Female** Babaye

4. Occupation Panginabuhi

□ **Farmer** Parag uma □ **Government official** Empleyado ha gobyerno

□ **Artist** Artisan □ **Student** Studyante

□ **Fisherman** Mangirisda □ **Company employee** Empleyado ha usa na kompanya

□ **Self-owned business** May kaugaringon nga negosyo

□ **Retired** Retirado □ **Unemployed** Waray trabaho

□ **Others; please specify:** Iba pa; alayon igsurat kun ano: _____

5. Highest educational attainment Pinakahataas na naabot na edukasyon

□ **No formal education** Waray pormal na edukasyon □ **Elementary** Elementarya

□ **High school** Hayskul □ **Vocational/ technical education** Bokisyonal na edukasyon

□ **Bachelor's Degree** Kolehiyo □ **Master's degree** Masteral

□ **PhD** doctoral □ **Others; please specify:** Iba pa; alayon igsurat kun ano:

_____

6. Place of residency: Guin uukyan na lugar: _____

7. How many years have you been residing in the area? Pira na ka-tuig an imo pag ukoy hiton na lugar?

□ **less than 5 years** 5 ka-tuig paubos □ **5-10 years** 5-10 ka-tuig □ **11-20 years** 11-20 ka-tuig

□ **21-30 years** 21-30 ka-tuig □ **30-40 years** 30-40 ka-tuig □**more than 40 years** sobra 40 ka-tuig

8. How many people are in your household? Pira kamo ha iyo balay?

□ **2-4 people** 2-4 ka tawo □ **5-8 people** 5-8 ka tawo □ **more than 8 people** sobra 8 ka tawo

9. How much is your monthly household income? Ha iyo balay, pira an kita kada bulan?
□ **less than Php5,000** 5,000 paubos □ **Php6,000-10,000** □ **Php11,000-20,000** □ **above Php20,000** sobra 20,000

10. Were you or a member of your family an employee in the former Bagacay Mine?
Miyembro ka ba o may usa na miyembro han iyo pamilya an trabahante han pagmina ha Bagacay?
□ **Yes** Oo □ **No** Diri

Section 2: Awareness on the rehabilitation efforts done in Bagacay Mine
Seksyon 2: Panhibaro han rehabilitasyon na ginhimo ha minahan ha Bagacay

1. Are you aware of the rehabilitation process being done in the former Bagacay Mine? Maaram ba kamo hiton proseso hit rehabilitasyon na guinhihimo han minahan ha Bagacay?
□ **Yes** Oo □ **No** Diri

2. Which component of the rehabilitation are you aware of? Check all that apply. Ano na parte han rehabilitasyon an imo nababaruan? Markahi it naangay o nasakto.
□ **environmental** pankalibungan □ **public health** panpubliko na kalusugan
□ **public safety** seguridad panpubliko □ **socio-economic** pan ekonomiya han sosyidad

3. Which source did you obtain the knowledge on rehabilitation from? Please choose any that applies. Diin kamo makabati hiunong han rehabilitasyon han minahan ha Bagacay? Pilia an naangay or nasakto.
□ **Official document**
(government office) Dokumento tikang han opisina han gobyerno
□ **Printed media (i.e. newspaper, magazines)** Mga printa ha newspaper, magazines
□ **Social media (i.e. internet, Facebook, Twitter, etc.)** Internet sugad hiton Facebook, Twitter, etc
□ **Personal communication (i.e. friends, family, colleagues)** Personal na pahibaro tikang ha sangkay, pamilya, kakilala
□ **Information and Education Campaigns by the government** Paghatag impormasyon han gobyerno

Section 3: Environmental impacts
Seksyon 3: Epekto ha kalibungan

Using the scale provided below, please tell whether you agree or disagree with the following statements regarding the rehabilitation of the former Bagacay Mine. Gamit an sukolan na nakabutang ha ubos, alayon igsumat kun nauyon ka o diri ka nauyon ha mga nasunod na kasuratan hiunong han rehabilitasyon han minahan ha Bagacay.

1	2	3	4	5
Strongly disagree Diri gud nauyon	**Disagree** Diri nauyon	**Unsure** Diri sigurado	**Agree** Nauyon	**Strongly agree** Nauyon hin duro

Issues Isyu	1	2	3	4	5
1. The tap water was safe to drink even when mining activities were present.					

Naiinom an tubig bisan mayada operasyon han mina hadto.					
2. The tap water is safe to drink now. Naiinom an tubig yana.					
3. The tap water has currently no distinct color. Waray klaro na kaibhan han kolor han tubig yana. **3.1. If you chose 1 or 2, what is the color of the tap water?** _____ Kun ginpili mo an 1 o 2, ano an kolor han tubig?					
4. The tap water has currently no distinct smell. Waray klaro na kaibhan han baho han tubig yana. **4.1. If you chose 1 or 2, what is the smell of the tap water?** _____ Kun ginpili mo an 1 o 2, ano an baho han tubig?					
5. The tap water has currently no distinct taste. Waray klaro na kaibhan han rasa han tubig yana. **5.1. If you chose 1 or 2, what is the taste of the tap water?** _____ Kun ginpili mo an 1 o 2, ano an rasa han tubig?					
6. The tap water has currently no distinct texture. Waray klaro na kaibhan han tekstura han tubig yana. **6.1. If you chose 1 or 2, what is the texture of the tap water? _____** Kun ginpili mo an 1 o 2, ano an tekstura han tubig?					
7. The water from the river has currently no distinct color. Waray klaro na kaibhan han kolor han salog yana. **7.1. If you chose 1 or 2, what is the color of the water from the river? _____** Kun ginpili mo an 1 o 2, ano an kolor han salog?					
8. The water from the river has currently no distinct smell. Waray klaro na kaibhan han baho han salog yana. **8.1. If you chose 1 or 2, what is the smell of the water from the river? _____** Kun ginpili mo an 1 o 2, ano an baho han salog?					
9. The water from the river has currently no distinct texture. Waray klaro na kaibhan han tekstura han salog yana. **9.1. If you chose 1 or 2, what is the texture of the water from the river? _____** Kun ginpili mo an 1 o 2, ano an tekstura han salog?					
10. The air has currently no distinct smell. Waray klaro na kaibhan han baho han hangin yana. **10.1. If you chose 1 or 2, what is the smell of the air?** _____ Kun ginpili mo an 1 o 2, ano an baho han hangin?					
11. The air has currently no distinct texture. Waray klaro na kaibhan han tekstura han hangin. **11.1. If you chose 1 or 2, what is the texture of the air?** _____ Kun ginpili mo an 1 o 2, ano an tekstura han hangin?					
12. The soil has currently no distinct color. Waray klaro na kaibhan han kolor han tuna. **12.1. If you chose 1 or 2, what is the color of the soil?** _____ Kun ginpili mo an 1 o 2, ano an kolor han tuna?					
13. The soil has currently no distinct smell. Waray klaro na baho han tuna. **13.1. If you chose 1 or 2, what is the smell of the soil?** _____ Kun ginpili mo an 1 o 2, ano an baho han tuna?					

14. There are no recent observations of soil erosion in Brgy. Bagacay. Waray na obserba na bag.o na pag anas hin tuna ha Brgy. Bagacay. **14.1. If you chose 1 or 2, what is the degree of observed soil erosion? Please choose below:** Kun ginpili mo an 1 o 2, gaano kadamo an na-obserba na pag anas han tuna? Alayon pagpili ha ubos: □ **minor** gutiay □ **moderate** durudamo □ **severe** gidamui					
15. Forests were not destroyed after the mining operation. Waray maruba an mga kagugub.an kahuman han operasyon han mina. **15.1. If you chose 1 or 2, what is the degree of observed deforestation? Please choose below:** Kun ginpili mo an 1 o 2, gaano kadako an nakalbo na guba? Alayon pagpili ha ubos: □ **minor** gutiay □ **moderate** durudamo □ **severe** gidamui					
16. Farmlands were not destroyed after the mining operation. Waray maruba an mga umahan kahuman han operasyon han mina. **16.1. If you chose 1 or 2, what is the degree of observed farmland destruction? Please choose below:** Kun ginpili mo an 1 o 2, gaano kadako an naruba na mga umahan? Alayon pagpili ha ubos: □ **minor** gutiay □ **moderate** durudamo □ **severe** gidamui					
17. The animals are coming back to the site because of the rehabilitation of Bagacay Mine. Nabalik an mga hayop han lugar tungod han rehabilitasyon na ginhimo ha minahan ha Bagacay.					
18. The rehabilitation efforts help in bringing the forest back in the former Bagacay Mine. Nakabulig an rehabilitasyon han pagbalik han guba han ginminahan na lugar ha Bagacay.					
19. I am satisfied with the rehabilitation efforts in terms of reducing the overall pollution. Kontento ako han rehabilitasyon na ginhimo para maibanan an kabug.usan na polusyon.					

Section 4: Health Impacts
Seksyon 4: Epekto ha Kalusugan

Using the scale provided below, please tell whether you agree or disagree with the following statements regarding the rehabilitation of the former Bagacay Mines. Gamit an sukolan na nakabutang ha ubos, alayon igsumat kun nauyon ka o diri ka nauyon ha mga nasunod na kasuratan hiunong han rehabilitasyon han minahan ha Bagacay.

1	2	3	4	5
Strongly disagree Diri gud nauyon	**Disagree** Diri nauyon	**Unsure** Diri sigurado	**Agree** Nauyon	**Strongly agree** Nauyon hin duro

Issues Isyu	1	2	3	4	5
1. Food consumption (e.g. crops, seafood, etc.) were not affected by the closing of Bagacay Mine.					

Waray ka apektuhi an konsumo han pagkaon (sugad hit mga duma, mga pagkaon ha dagat, etc.), han iginpasara an minahan ha Bagacay.					
2. There were no reported cases of poisoning from toxic metals. Waray nabalita na mga kaso hin pagkalason gikan han mga nakakalason na mga metal.					
3. There were no reported cases of skin problems caused by the water flowing from Bagacay Mine. Waray nabalita na mga kaso hin mga problema ha panit dara han tubig na naagos tikang ha minahan han Bagacay.					
4. There were less health issues related to mining pollution when the rehabilitation began. Naibanan an mga isyu pan kalusugan na dara han polusyon han mina ha Bagacay han nagtikang an rehabilitasyon.					

Section 5: Socio-economic Impacts
Seksyon 5: Epekto ha pan ekonomiya han sosyidad

Using the scale provided below, please tell whether you agree or disagree with the following statements regarding the rehabilitation of the former Bagacay Mines. Gamit an sukolan na nakabutang ha ubos, alayon igsumat kun nauyon ka o diri ka nauyon ha mga nasunod na kasuratan hiunong han rehabilitasyon han minahan ha Bagacay.

1	2	3	4	5
Strongly disagree Diri gud nauyon	**Disagree** Diri nauyon	**Unsure** Diri sigurado	**Agree** Nauyon	**Strongly agree** Nauyon hin duro

Issues Isyu	1	2	3	4	5
1. There were no conflicts between the mining company and the local people during the mining operation. Waray samok na nahitabo ngada han kompanya han minahan ngan ha mga tawo han nagmimina.					
2. There were no cases of child labor during the mining activities in Bagacay. Waray mga bata nga nagmimina ha Bagacay.					
3. There were community consultations done regarding the rehabilitation of Bagacay Mine. Mayda ginbuhat na pagkonsulta hiunong han rehabilitasyon na ginhimo ha minahan ha Bagacay.					
4. The results of the rehabilitation of Bagacay Mine are available to the local people. Nakikita han mga tawo an resulta han rehabilitasyon han minahan ha Bagacay.					
5. There were information and education campaign regarding the rehabilitation of Bagacay Mine. Ginpasabot an mga tawo hiunong han rehabilitasyon ha minahan han Bagacay.					
6. Although there are on-going mining operations, people are not moving out of the residential area. Bisan nagmimina, waray babalhin an mga tawo han ira gin uukyan na lugar.					
7. My family is more well-off before the mining operations began in Bagacay.					

Mas maupay an kamutangan han akon pamilya han waray pa magtikang an pagmina ha Bagacay.					
8. My family is less well-off before the mining operations began in Bagacay. Mas diri maupay an kamutangan han akon pamilya han waray pa magtikang an pagmina ha Bagacay.					
9. My family's income did not change before the mining operations began in Bagacay. Waray mag bag o an kita han akon pamilya han waray pa magmina ha Bagacay.					
10. My family is more well-off during the mining operations in Bagacay. Mas maupay an kamutangan han akon pamilya han nagmimina na ha Bagacay.					
11. My family is less well-off during the mining operations began in Bagacay. Mas diri maupay an kamutangan han akon pamilya han nagmimina na ha Bagacay.					
12. My family's income did not change during the mining operations in Bagacay. Waray mag bag.o an kita han akon pamilya han nagmimina na ha Bagacay.					
13. My family is more well-off after the mining operations in Bagacay. May maupay an kamutangan han akon pamilya kahuman han pagmina ha Bagacay.					
14. My family is less well-off after the mining operations in Bagacay. Mas diri maupay an kamutangan han akon pamilya kahuman han pagmina ha Bagacay.					
15. My family's income did not change after the mining operations in Bagacay. Waray mag bag.o an kita han akon pamilya kahuman han pagmina ha Bagacay.					
16. The rate of fish catches increased when the rehabilitation began. Mas damo an nadadakop na isda han nagtikang an rehabilitasyon han minahan.					
17. The rate of fish catches decreased when the rehabilitation began. Mas gumuti an nadadakop na isda han nagtikang an rehabilitasyon han minahan.					
18. The rate of fish catches did not change when the rehabilitation began. Waray mag bag.o an kadamo han nadadakop na isda han nagtikang an rehabilitasyon han minahan.					
19. There were no reported cases of fish deaths before the mining operations began in Bagacay. Waray nabalita pagkamamatay hin isda han waray pa magmina ha Bagacay.					
20. There were no reported cases of fish deaths during the mining operations in Bagacay. Waray nabalita hin pagkamamatay hin isda han nagmimina ha Bagacay.					
21. There were no reported cases of fish deaths when the rehabilitation began. Waray nabalita hin pagkamamatay hin isda han nagtikang an rehabilitasyon han minahan.					

22. The local economy is more stable before the mining operations began in Bagacay. Mas establisado an ekonomiya san o nag mina ha Bagacay.					
23. The local economy is less stable before the mining operations began in Bagacay. Mas diri establisado an ekonomiya san.o nag mina ha Bagacay.					
24. The local economy is more stable during the mining operations in Bagacay. Mas establisado an ekonomiya han nagmimina ha Bagacay.					
25. The local economy is less stable during the mining operations in Bagacay. Mas diri establisado an ekonomiya han nagmimina ha Bagacay.					
26. The local economy is more stable after the mining operations in Bagacay. Mas establisado an ekonomiya kahuman han pag mina ha Bagacay.					
27. The local economy is less stable after the mining operations in Bagacay. Mas diri establisado an ekonomiya kahuman han pag mina ha Bagacay.					
28. Mining helped the economic development in the local community. Nakabulig an pagmina han pag asenso han ekonomiya han komunidad ha Bagacay.					
29. Samar's economy can be stable even without mining. Establisado an ekonomiya han Samar bisan waray mina.					
30. The remaining minerals in the former Bagacay mine should be re-mined. It is alright to perform extractive activities again. Kinahanglan minahon an nasasalin na mineral ha minahan ha Bagacay.					

Section 6: Rank the following components of mine rehabilitation in order of increasing importance to you (1 being the most important and 4 being the least important):
Seksyon 6: Ranggoha an mga parte han rehabilitasyon tikang han pinakaimportante na parte (1 an pinakaimportante ngan 4 an pinakadiri importante):

□ environmental pan kalibungan
□ public safety seguridad panpubliko
□ public health panpubliko na kalusugan
□ socio-economic pan ekonomiya han sosyidad

Additional comments about the rehabilitation in Bagacay Mine:
Dugang na komento hiunong han rehabilitasyon han minahan ha Bagacay.

_____
_____
_____
_____

Thank you very much for your participation!
Damo na salamat han iyo partisipasyon!

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