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Collaborative Post-Mining Area Management in Kampoeng Reklamasi Air Jangkang, Bangka Regency, Indonesia

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Abstract

The mining sector is one of the significant contributors to revenue structure of the country but despite evident material benefits, certain problems often occur. One example is found in Tin mining, where aside from creating pits, reclaimed post-mining areas still retain the potential for community cultivation due to residual tin deposits. To address these concerns, efforts have been made to engage various stakeholders through the collaborative management method in the post-mining area. Currently, this method is being implemented in Kampoeng Reklamasi Air Jangkang, Merawang District. Therefore, this study aimed to measure the achievements of collaborative post-mining area management implemented at Kampoeng Reklamasi Air Jangkang. The mixed methods were used with a concurrent design measured through three variables, namely Economic, Social, and Ecological. The results showed that collaborative post-mining area management fell into the "successful" category with a success coefficient of 83.64%. Although positive changes were observed, improvements were needed in several aspects to achieve greater impacts. The impacts were also currently localized to specific program indicators within the region showing the need for more in-depth studies at a broader level and scale to measure the changes generated on a larger scope.

Keywords: *Management; Collaborative; Post-mining Area*

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Abstrak

Sektor pertambangan menjadi salah satu sektor yang berkontribusi besar dalam struktur pendapatan negara. Namun, dibalik keuntungan materiil yang diterima, persoalan-persoalan yang ditimbulkan kerap terjadi. Salah satu contoh terjadi pada pertambangan Timah, selain menyisakan lubang-lubang bekas galian, kawasan pascatambang yang telah dilakukan upaya reklamasi oleh perusahaan masih berpotensi untuk digarap kembali oleh masyarakat karena masih dapat ditemukan sisa-sisa endapan timah. Salah satu upaya yang dilakukan pada kegiatan reklamasi yaitu dengan melibatkan berbagai stakeholders melalui pendekatan *Collaborative Management*. Saat ini, pengelolaan kawasan pascatambang yang telah dilakukan dengan menggunakan pendekatan *Collaborative Management* berada di Kampoeng Reklamasi Air Jangkang, Kecamatan Merawang. Penelitian ini bertujuan untuk mengukur capaian pengelolaan kawasan pascatambang secara kolaboratif yang dilaksanakan di Kampoeng Reklamasi Air Jangkang. Metode yang digunakan dalam penelitian ini yaitu Metode Penelitian Campuran (Mixed Methods) dengan model *concurrent design* yang diukur melalui tiga variabel yaitu Ekonomi, Sosial dan Ekologis. Dari penelitian yang telah dilakukan diperoleh hasil capaian pengelolaan kawasan pascatambang secara kolaboratif yang dilakukan di Kampoeng Reklamasi Air Jangkang masuk ke dalam kategori "berhasil" dengan koefisien keberhasilan sebesar 83,64%. Secara dampak yang dihasilkan telah memberikan perubahan ke arah positif namun masih perlu adanya perbaikan di beberapa sisi agar dapat membawa perubahan yang lebih baik lagi. Selain itu, pada beberapa indikator, dampak masih dirasakan dalam skala program yang berada dalam lingkup kawasan. Perlu dilakukan kajian yang lebih mendalam serta pada level dan skala penelitian yang lebih luas, agar dapat mengukur dampak yang dihasilkan dalam lingkup yang lebih besar.

Kata kunci: Pengelolaan; Kolaboratif; Kawasan Pascatambang

INTRODUCTION

Mining and Quarrying is one of the sectors that support the economic strength of revenue. Indonesia in particular, is a fertile ground for the industry due to its abundant natural resource potential, including minerals and energy. Sudrajat (2018) argued that the economic value of mining materials in the country is immense, serving as a source of state revenue to fund development activities and foster welfare. The positive aspects include job creation, poverty reduction, and meeting domestic industry needs, eventually becoming the main catalyst for driving the national economy. However, the sector faces various problems, namely environmental degradation that potentially causes landscape changes and environmental damage, as well as social problems when mining does not follow the principles of good practices. Brodny (2017) stated that mining exploitation can cause very significant changes in the natural environment.

Bangka Belitung Islands Province is one of the operational areas with greater potential to contribute

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significantly to state revenue through tin mining. One of the companies engaged in this activity is PT Timah Tbk. where mining cannot be separated from the impacts as also stated by Manik (2018). To minimize environmental impacts in the area, PT Timah Tbk. is obligated to conduct reclamation and post-mining management efforts. However, these efforts are often faced with various problems. As stated in a previous study conducted by Sari & Buchori (2015) in Bangka Regency, it was found that the tin post-mining reclamation program implemented in the Merawang District was ineffective. Several issues such as UT (Unconventional Mining) and Illegal logging activities carried out by the local community on PT Timah Tbk. reclamation land were identified. Furthermore, Kivinen (2017) suggested the need for increased attention to new mining activities on post-mining landscapes, preventing degradation and underutilization from an environmental, social, and economic perspective. Ibrahim (2015) mentioned that UT persisted in the former mining area of PT Timah Tbk. with open tin deposits facilitating these activities. This study explores independent reclamation and post-mining efforts, using resources from other mining companies.

In 2016, PT Timah Tbk. offered the management of post-mining areas to the community through a community-based system. However, several obstacles were encountered in the readiness of the community to manage the area. Apart from independent and community-based methods, the company can also engage other parties using Collaborative Management method. Kusumanto et al. (2006) described Collaborative Management as a process in which all stakeholders actively participate in various activities, including developing a shared vision, learning together, and adapting management practices. According to Camarihna-Matos & Afsarmanesh (2008), collaboration is when several entities or groups share information, resources, and responsibilities for a program of activities jointly designed, implemented, and evaluated to achieve mutually agreed goals. As stated by Kuhn (2016), collaborative governance has the potential to use knowledge from a greater variety of sources and provide wider access to the community and institutions. Arratia-Solar et al. (2022) also suggested the need for mechanisms to interject inputs from multiple stakeholders and disciplinary perspectives at a regional scale to optimize land use change outcomes and maximize stakeholder buy-in.

Given the current challenges, PT Timah Tbk. through its subsidiary, PT TAM (Timah Agro Manunggal) has been using Collaborative Management method in managing post-mining areas, specifically in Kampoeng Reclamation Air Jangkang since 2016, covering an area of 37 Ha. This method, entailing actors in the pentahelix element is rare in post-mining areas, specifically in this location. Nita and Myga-Piatek (2006) also mentioned the need for interdisciplinary joint projects in post-mining area landscape formation.

This study aimed to examine the achievements of post-mining area management carried out

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collaboratively. The results provide benefits in the form of scientific contributions to environmental analysis related to post-mining land management. Furthermore, this study is expected to serve as a reference material for further investigations in other areas.

METHODS

The study was conducted from November 2022 to December 2022 at the tin post-mining area owned by PT Timah Tbk. in Air Jangkang, Riding Panjang Village, Merawang District, Bangka Regency, Bangka Belitung Islands Province. The mixed methods, a combination of qualitative and quantitative, were used with concurrent design. These methods were used simultaneously but independently to answer similar problem formulations. In making measurements, three variables were used, namely economic, social, and ecological, which were then derived into several dimensions and indicators. The variables, dimensions, and indicators are shown in Table 1.

Table 1. Study Variables, Dimensions, and Indicators

Variable	Dimension	Indicator/ Parameter
Economic	Post-mining economic activity.	Revenue sources for post-mining area reclamation activities.
	Impact on community income.	Percentage of working community that experience an increase in income.
	Creation of new business opportunities.	Community interest in visiting the post-mining area.
		Availability of new businesses in post-mining areas.
Social	Equity	The existence of equal rights between stakeholders in playing a role.
		Coverage of beneficiaries in post-mining area management.
	Empowerment	Planned and collective activities.
		Improving community's lives.
		Priority for weak or disadvantaged groups.
		Conducted through capacity building programs.
	Conflict resolution	Scope of conflicts resolved in post-mining areas.
	Community awareness of the environment.	Level of community awareness regarding the importance of protecting the environment.
	The community relations with the mining company.	The creation of good relations between the company and the local community.
	Worker absorption.	Scope of employment of local community.
	Community participation.	Contributions.
		The existence of organization.
		Community roles and actions.
		Community motivation.
		Community responsibility.
Ecological	Land surface arrangement.	Area laid out.
		Embankment stability.
	Backfilling of ex-mining land.	Area stockpiled.
		Embankment stability.
	Spreading rooting zone soil.	Stocked area.
		Soil pH.
	Erosion control and water management.	Drainage channel.
		Erosion control building.
	Planting.	Planting area.
		Plant growth.
	Acid mine drainage plant material management.	Material management
		Erosion control building.
		Sediment settling pond.
	Canopy closure	Percentage of area with canopy closure.
	Maintenance.	Fertilization.
		Weed, pest, and disease control.
		Embroidering.

The score of the indicator in each dimension was used in conducting the final analysis on the success achievements of all variables. The results were used and processed to calculate the success coefficient at the variable level up to the achievement of post-mining area management. The

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scoring description is shown in Table 2 below.

Table 2. Scoring and Level of Management Success.

Score	Description	Coefficient	Category
1	There have been several changes for the worse, and have had wider impacts.	0%-19.99%.	Unsuccessful
2	There is some change for the worse, but it is still on a project scale.	20%-39.99%	Unsuccessful
3	No change.	40%-59.99%	Less Successful
4	There has been some change for the better, but it is still happening on a project scale.	60%-79.99%	Successful
5	There have been several changes for the better and have had a wider impact.	80%-100%	Successful

RESULTS AND DISCUSSION

The study showed that the initial condition of the post-mining area in Kampoeng Reclamation Air Jangkang before reclamation resembled a typical former mining area. The land was included in the infertile category, generally dominated by tailings sand, significantly low content of macro and microelements, limited or even missing topsoil, acidic water/soil properties (pH 4-5), poor nutrient content, low water binding capacity, susceptibility to erosion, and low microbiology. Initially, there were community efforts to re-encroach the area during its early stages of reclamation. The development concept of Kampoeng Reklamasi Air Jangkang is currently divided into three units, namely agronomy, education, and tourism. In the agronomy sector, the location was strategically designed as an integrated agricultural/plantation area, incorporating the cultivation of fruits, vegetables, forestry, and endemic plants typical of the Bangka Belitung Islands. As an educational facility, Kampoeng Reklamasi Air Jangkang was used in various activities including cattle farming, composting liquid organic fertilizer, inland aquaculture with biofloc technology, Hydroponics, Tissue Culture Nursery, and Animal Rescue Center. Meanwhile, as a tourism area, this area was used for building various photo spots, stilt houses, water recreation, and other tourist support buildings namely public toilets, prayer rooms, and lodges. Furthermore, the achievements of post-mining area management were measured, and the following results were obtained.

A. Economic Variables

In measuring economic variables, this study used three dimensions including post-mining economic activity, impact on community income, and the creation of new business opportunities. The results obtained in each dimension are described below.

1. **Post-mining Economic Activity.** The transformation into an agronomic area entails the cultivation of fruits, vegetables, and forest plants. The harvests obtained at Kampoeng Reclamation Air Jangkang were not commercially sold but rather used for communal consumption by the company, the community, and visitors. One source of income for this area is from the sale of entrance tickets. Although currently not open to the public, various visits have been

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made by schools, community groups, and agencies. This showed an improvement from the condition before the post-mining area was managed. At present, this source of income in economic activity is only available within the area.

2. **Impact on Community Income**.
   Based on the census regarding the perceptions of participants, 57.14% strongly agreed, and 35.71% agreed that the current reclamation program had an impact on increasing their income, while 7.14% disagreed. At the community level, showing a widespread impact on increased income may be challenging. However, at the individual level, positive achievements have been observed. Mass replication of this program in other locations has the potential to improve the economy at the community level.
3. **Creation of New Business Opportunities**.
   Based on the observation in the field, several groups often visit this location, particularly students and educators who conduct study tours to understand the use of tin post-mining areas. The impact of these visits was not only felt at Kampoeng Reklamasi Air Jangkang but also by the local community, such as food stalls, grocery stores, and others. Despite initially being an infertile ex-mining land with many pits, collaboration in its management has led to the creation of new businesses, including nursery, plant care services, animal husbandry, cleaning, hydroponics, improved road access, and harvesting. Presently, these new business opportunities were confined to the area, but with future developments, including food court facilities, the impact could be extended further.

From the description above, the measurement results on economic variables are presented in Table 3 below.

Table 3. Success Level of Economic Variables

Variable	Dimension	Indicator	Score	Category
Economic	Post-mining economic activity.	Revenue sources for post-mining area reclamation activities.	4	Successful
	Impact on community income.	Percentage of working community that experience an increase in income.	4	Successful
	Creation of new business opportunities.	Community interest in visiting the post-mining area.	5	Successful
		Availability of new businesses in post-mining areas.	4	Successful
		Total Score	**17**	Successful
		Coefficient	**85.00**	Successful

B. Social Variables

In the assessment of social variables, this study used seven dimensions, including Equity, Empowerment, Conflict Resolution, Community awareness of the environment, Community relations with mining companies, Worker absorption, and Community participation. The results obtained in each dimension are described below.

1. **Equity.** Regarding the equality of rights, in-depth interviews with

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stakeholders showed instances such as ALOBI being granted the right to manage 4 Ha of space within the Kampoeng Reklamasi Air Jangkang post-mining area. The role is solely independent without any intervention from any party, preserving and safeguarding animals in the location or those from outside the area. Similar autonomy was granted to academic stakeholders, namely UBB, who were given the right to manage land as a study location. PT Timah Tbk. provides funding support in several activities, but UBB professionally conducts various studies by educators and students. In addition, the local government has similar rights to collaborate in the development of this post-mining area, contributing to road improvement activities that benefit both the region and the surrounding community. The existence of Kampoeng Reklamasi Air Jangkang serves as a new source of income for the local government, the company, and provides direct learning facilities for academics related to post-mining land use.

2. **Empowerment.** Activities within the post-mining area were carried out in a planned manner starting from the closure of mining to the current management through the development concept of "Agronomy, Education, and Tourism". In its implementation, community workers as participants contribute to managing this area in several fields of work including nursery, plant maintenance, bioflocs, animal husbandry, clearing, cleaning, construction of infrastructure, and tissue culture laboratories. The positive impact is currently evident among the participating workers, with potential wider effects anticipated as the tourism concept develops. However, no activities specifically prioritize the weak or disadvantaged groups in this location, compared to activities in the CSR (Corporate Social Responsibility) program. Capacity-building programs have been implemented and to increase capacity, two workers are currently being trained in tissue culture in Bogor Regency. In addition, similar training has previously been conducted for workers in hydroponic and biofloc tasks, yielding positive impacts within the community.
3. **Conflict resolution.** Initially, attempts at re-mining by the community posed a challenge during the reclamation process. However, PT Timah Tbk. effectively addressed this issue by collaborating with the local village government. This collaborative method used in managing the area has proven effective for averting conflicts, with no re-mining incidents.
4. **Community awareness of the environment.** This study measured the perceptions of community awareness of the environment. Based on the results, 100% of the participants strongly agreed that the Kampoeng Reklamasi Air Jangkang Area reclamation program played a crucial role in improving environmental quality. The majority of the participants were fully aware

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that re-mining efforts would worsen environmental quality. Re-vegetation efforts were acknowledged as beneficial for improving environmental quality. Moreover, community workers realized the shared responsibilities of all parties, beyond the government and business actors, in preserving the environment. This awareness has resulted in positive changes but these results are still within the scope of the participants, showing the need for a broader study to determine the impact on a larger scale.

5. **Community relations with the mining company.** The relationship between the local community and the company is currently positive. The transformation of Kampoeng Reklamasi Air Jangkang into an agro-edutourism area has minimized and even eliminated mining efforts carried out by the community. The harmonious relationship between the community and PT Timah Tbk. could be attributed to the development of the area, supported by the road paving courtesy of the Bangka Regency Government. This improvement in infrastructure benefits the local community by providing enhanced road access. Since PT TAM assumed the management of Kampoeng Reklamasi Air Jangkang, there have been no conflicts reported by the community to date. This impact is not only felt within the area but potentially also in the surrounding environment.
6. **Worker absorption.** Workers engaged under the contract have been integrated into the workforce at PT Timah Tbk. and PT TAM. However, a piecework system was implemented for activities conducted within a specific timeframe. In the recruitment process, PT Timah Tbk. communicates with the local village government, seeking information to absorb workers from the location. This method has led to positive changes compared to the pre-management era. The impact extends beyond the scope of the area, providing job opportunities for the local community.
7. **Community participation.** The community actively participates in managing Kampoeng Reklamasi Air Jangkang, with easy access to contribute to various tasks including nursery, clearing, cleaning, fruit/plant maintenance, bioflocs, animal husbandry, construction of supporting facilities and infrastructure, administration, as well as tissue culture laboratories. Additionally, community contributions extend to animal conservation efforts through collaboration with the "ALOBI Foundation". This partnership focuses on wildlife conservation by building and forming natural ecosystems in post-mining areas. In practice, no community organization has been specifically formed, but the community workers can channel their aspirations through PT TAM and PT Timah Tbk. The absence of attempts to re-encroach the reclaimed area underscores the collective commitment of the local

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community. Based on the results, 92.86% of participants felt very encouraged and were willing to invite their relatives, family, and other communities to help preserve the post-mining area. Moreover, all participants agreed that the preservation of Kampoeng Reklamasi Air Jangkang was not only the responsibility of the management but also joint community efforts. This participation needs to be continuously increased to achieve widespread impact.

From the description above, the measurement results on social variables are presented in Table 4 below.

Table 4. Achievement Level of Social Variable Success

Variable	Dimension	Indicator	Score	Category
Social	*Equity*	The existence of equal rights between stakeholders in playing a role.	5	Successful
		Coverage of beneficiaries in post-mining area management.	5	Successful
	Empowerment	Planned and collective activities.	5	Successful
		Improving the community's lives.	4	Successful
		Priority for weak or disadvantaged groups.	3	Less Successful
		Conducted through capacity building programs.	4	Successful
	Conflict resolution	Scope of conflicts resolved in post-mining areas.	5	Successful
	Community awareness of the environment	Level of community awareness regarding the importance of protecting the environment.	4	Successful
	Community relations with mining companies	The creation of good relations between the company and the local community.	5	Successful
	Worker absorption	Scope of employment of the local community.	5	Successful
	Community participation	The existence of contributions.	5	Successful
		The existence of organization.	4	Successful
		Community roles and action.	4	Successful
		Community motivation.	4	Successful
		Community responsibility.	4	Successful
		Total Score	**66**	Successful
		Coefficient	**88.00**	Successful

C. Ecological Variables

To measure the ecological variables, success criteria were used as stipulated in Attachment IV of the Minister of Energy and Mineral Resources Regulation Number 7 of 2014 concerning the Implementation of Reclamation and Post-Mining in Mineral and Coal Mining Business Activities. This includes standards for land utilization, re-vegetation, and final resolution.

1. **Land Surface Arrangement.** The dimensions of the land surface arrangement were measured using parameters, namely "the area to be arranged" and "stability of the backfilling". The planned area for the arrangement was 37 Ha, and this was successfully realized. In general, positive changes have been introduced in the post-mining area. The stability of the backfilling was considered stable, with no landslides.

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2. **Backfilling of Ex-Mining Land.** The dimensions of backfilling were measured using several parameters, namely "the area to be backfilled" and "stability of backfilling". In terms of the area to be backfilled, it was planned to cover 2.28 Ha with a realization of 1.68 Ha. Other areas without reclamation had been designated for water tourism, while the rest were still in the development and construction stages. This condition represents an improvement from the pre-management era. The stability of the backfilling was categorized as stable because no landslides were found in the area.
3. **Spreading Root Zone Soil.** In the dimensions of spreading root zone soil, measurements were carried out using several indicators or parameters, namely "the area of the spread" and "pH of the soil". The planned spread area was 31.1 Ha with a realized area of 27.5 Ha. The coverage area spread was in a good category, surpassing the standard of success (> 75%). The planting had a positive ecological impact on the area, while the soil pH parameter obtained was 4.92, categorized as acidic. These results show that there has been no improvement in soil conditions in the post-mining area compared to the pre-management era.
4. **Erosion Control and Water Management.** In the dimensions of erosion control and water management, measurements were carried out through several indicators, namely "drainage channels" and "erosion control buildings". In drainage channels, it was planned that there would be no active erosion and sedimentation on the land. However, in reality, minimal erosion, which could have been prevented still occurred. Compared to the initial conditions before the arrangement, the land conditions were easily eroded. This condition was significantly better than in the pre-management era.
5. **Planting.** In the planting dimension, measurements were conducted through several indicators, namely "Planting area" and "Plant growth." For the planting area, it was planned to cover 27.5 Ha with an actual realization of 27.5 Ha. The planting area included cover crops (27.5 Ha), fast-growing plants (18.97 Ha), as well as (1 Ha) for Pelawan forest plants, and (7.53 Ha) for local fruits. Although positive impacts are currently felt within this region, more in-depth studies are needed to examine the influence on a larger scale. For the plant growth parameter, it was planned to cover 27.5 Ha with an actual realization of 27.5 Ha, and a success rate of 100%. The plant growth falls into the good category, surpassing the success standard (> 80%). According to Zhong et al. (2023), re-planting the topsoil using local key species is a desirable practice that can enhance the biological properties of the soil and benefit the restoration of the mining site.
6. **Management of Acid Mine Water Generator Materials.** In the dimensions of acid mine generator

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material management, measurements were not carried out because there was no acid mine drainage in the Kampoeng Reklamasi Air Jangkang post-mining area.

7. **Canopy closure.** The canopy closure dimension was measured using one indicator, namely "coverage of canopy closure". It was planned to cover > 80, with the realization of > 80%, surpassing the success standard (>=80%). This provides better changes compared to the conditions before management.
8. **Maintenance.** In the maintenance dimension, activities were carried out within the area, hence, the impact was confined to a regional scale. Measurements were conducted using several indicators, namely "fertilization", "control of weeds, pests, and diseases," as well as "re-planting". Fertilization was planned with an average use of NPK fertilizer at a dose of 1 kg/plant with the realization of 1 kg/plant according to the required dose. Control of weeds, pests, and diseases was performed using a dose of 1 ml/L, adjusted in line with the specific needs. Meanwhile, re-planting was carried out in response to plant losses.

From the description above, the measurement results on social variables are presented in Table 5 below.

Table 5. Ecological Variable Success Level

Variable	Dimensions	Indicator	Score	Category
Ecological	Land surface arrangement	The size of the area laid out.	4	Succeed
		Embankment stability.	4	Succeed
	Backfilling of ex-mining land	The area covered.	4	Succeed
		Embankment stability.	4	Succeed
	Spreading the root zone soil	The size of the area spread.	4	Succeed
		Soil pH.	3	Less successful
	Erosion control and water management	Drainage channel.	4	Succeed
		Erosion control building.	4	Succeed
	Planting	Planting area area.	4	Succeed
		Plant growth.	4	Succeed
	Management of acid mine water generator materials	Material management.	-	-
		Erosion control building.	-	-
		Sediment settling pond.	-	-
	Canopy Closure	Percentage of area where canopy closure has been carried out.	4	Succeed
	Maintenance.	Fertilization.	4	Succeed
		Control of weeds, pests and diseases.	4	Succeed
		Re-planting.	4	Succeed
		Total Score	**55**	Succeed
		Coefficient	**78,57**	Succeed

CONCLUSION

In conclusion, from all the indicators measured, the collaborative post-mining area management carried out in Kampoeng Reklamasi Air Jangkang was in the "successful" category with a success coefficient of 83.64%. The highest success rate was obtained in the social variable, with a success coefficient of 88.00%. The impacts on the three variables showed positive changes. However, improvements were needed in several aspects to achieve better changes. Efforts to re-mine areas that had been reclaimed ceased after collaborative management was implemented. Based on the results, some impacts remained

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on a regional program scale. Therefore, more in-depth studies on a wider level and scale are needed to measure the impact produced in a larger scope.

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