

Transforming ex-small scale mining land as farming areas for sustainable development and poverty alleviation

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Abstract. When the price of manganese ores in 2012, mining activities declined or even terminated. Ex-miners lose an important source of income, but they did not have any other alternative except going back to slash and burn cultivation, producing enough only for their own food. Their hope for a better live was gone and at the same time they faced stigmatisation as causing environmental degradation from the rest of the community. We carried out this case study to follow ex-miners in the Tubuhue village who organised themselves to do post-mining rehabilitation by turning the former mining site into an area of productive farming. In-depth interview, field observation and focus group discussion were conducted from 2015 to 2017. We found that during the period of mining boom, slash and burn cultivation decrease significantly but began to increase after no mining activities. Various social transformations took place along with this land use change, but the most important was the miners' decision to do mining as an organised activity. A strong leader of this organization played a pivotal role in turning the former mining site into an area of productive sedentary farming. This was carried out by organizing the ex-miners into farmers groups and together, constructing drip and sprinkler irrigation networks to water their crops using rain water collected in the mining holes that they had turned into small check-dams. The leader expected that this farming could provide an alternative for ex-miners to obtain cash income to limit them going back doing swidden farming.

1. Introduction

The small-scale manganese mining provided the drought-prone swidden farmers of West Timor an opportunity for obtaining instant cash income. By simply digging in their own land, a small-scale miners could obtain 50 to 150 kg of manganese ores a day with a price of IDR 800 to IDR1,500 per kg. For an average ores of 100 kg a day and an average price of IDR 1,150 per kg, one would receive Rp 115,000 cash income a day, a sum of money far larger from what a person could earn from any other job in rural areas. Swidden farmers used the cash income to improve their living condition while they continued to rely on swidden farming to produce their food. According to Dara, the significance



of the economic benefits derived from artisanal small-scale mining activities can be identified by the changes in their capacity to fund their basic needs such as food, water and sanitation, adequate housing, and basic education. This way, Dara [1] continued, small-scale manganese mining created alternative livelihoods.

When in 2012 the price of manganese ores crashed, those alternative livelihoods were gone. There was no other alternative available except going back to their abandoned swidden farm to produce food for their own household and to raise cattle, pig, or chicken to obtain much smaller cash income [1–3]. Those who could not afford to do so, relied on rice-for-the-poor ration provisioned by the government [4,5]. Their hope for a better future suddenly gone with the wind that crashed the price of manganese ores. What even worse, those abandoned swidden farming for mining had faced stigmatization as causing environmental degradation from the rest of the community.

This article presents a case study about the impact of artisanal small-scale manganese mining on the environment and the struggle of ex-miners to continue their life after the collapse of the mining in 2012. This research was part of a larger multi-years research project on environmental and social impacts of small-scale artisanal mining in Eastern Indonesia. The research in West Timor was focused on artisanal small-scale mining involving local communities. In the final year, research in West Timor was more focused on small-scale mining sites in Noelmina catchment.

2. Materials and Methods

We carried out this case study in the village of Tubuhue, sub-district of west Amanuban, South Central Timor District, as part of a larger research project encompassing the whole area of Noelmina catchment. The village was once the most vibrant artisanal small-scale manganese mining location in the catchment during the mining boom in 2008-2012 and where ex-miners have successfully organised themselves to turn former mining sites into a centre of horticultural crop production.

Tubuhue, one of villages within the catchment where artisanal small-scale manganese mining, was most vibrant during the peak of manganese mining in the region. We particularly interested to this village because those involved in mining activities in this village had been from the beginning aware of the impacts of their activities and mobilized efforts to make the mining beneficial for their community.

For the purpose of this case study, we collected social and physical data during the period of 2015-2017. For the collection of social data consisting of working processes and human behaviors, we followed three farmers groups which members consisted of those formerly involved in artisanal small-scale manganese mining on site. During our several visits, we discussed reasons they engaged in group farming in ex-mining sites, observed their day-to-day farming practices, and invited members of the farmer groups to attend focus group discussion we carried in the village and in Kupang. For land use analysis, we downloaded path 110 and row 67 of Landsat 8-OLI (Operational Land Imager) image year 2013 and 2017 and Landsat 5 TM (Thematic Mapper) year 2009 from USGS website (<https://speclab.cr.usgs.gov>). We choose the path and row of the image for reasons of reasonable cloud-free cover (less than 10% cloud cover) and adequate spectral information from the intensity over 80% irradiation as shown in Figure 1.

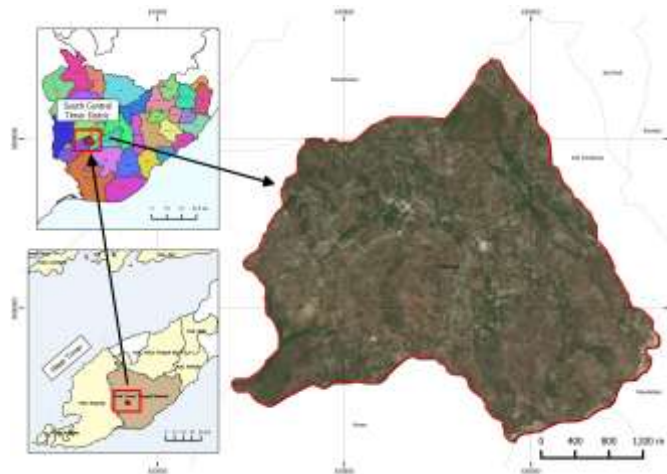


Figure 1. Research site and its land cover characteristics

We employed a thematic analysis technique to analyse data resulting from in-depth interview, field observations, and focus group discussion. We did the analysis in a naturalistic approach by treating the data in their natural setting along a continuum of data reduction, data display, and drawing conclusion [6]. We followed the recommendation of UNCCD (United Nations Conventions to Combat Desertification) in analysing land cover change by using Normalized Difference Vegetation Index (NDVI) with three cluster NDVI score for vegetation classification (Table 1). NDVI had been proven useful for mapping of vegetation, vegetation typology and land use analysis [7,8]. We carried out this spatial analysis using SAGA (System for Automated Geo-scientific Analyses) 5 and Quantum GIS 2.18 open-access GIS software.

Table 1. NDVI scores and their land cover characteristics.

Score	Land cover characteristics
≤ 0.2	Barren soil, open ground, and rock outcrops
$0.2 - 0.3$	Grassland, shrubs, agricultural areas, and dry forest
$0.3 - 1$	Closed vegetation (forest)

3. Results and Discussion

We present and discuss this research finding in three sections. We start with land use transformation in the first section, social transformation in the second section, and finally, mining activities in the last section. The explanation of those sections is as follows.

3.1. Land use transformation

In analysing land use change, we used the 2009 land cover as the baseline data, the 2013 land cover as measures of mining impacts, and the 2017 land cover as measures of impacts of the shift from swidden farming to more sedentary farming activities. As shown in Figure 2, the 2009 land cover was dominated by open land and shrubs, indicating the dominance of swidden farming prior to the start of artisanal small-scale manganese mining. The 2013 land cover showed a shift from open land and shrub to shrubs and forest, indicating significant reduction of swidden activities because during the period from 2009 to 2013, people engaged more in mining than in swidden farming. During this period, the area of open land had been also significantly reduced from 206 ha to only 0.19 ha. This land cover change indicated that the artisanal small-scale manganese mining had become a more attractive alternative to swidden farming. Being small-scale, these mining activities did not necessary open a large track of land that contributed significantly to land cover change. In fact, the mining was carried out by simply collecting ores already exposed above ground or by digging small pits under the forest trees.

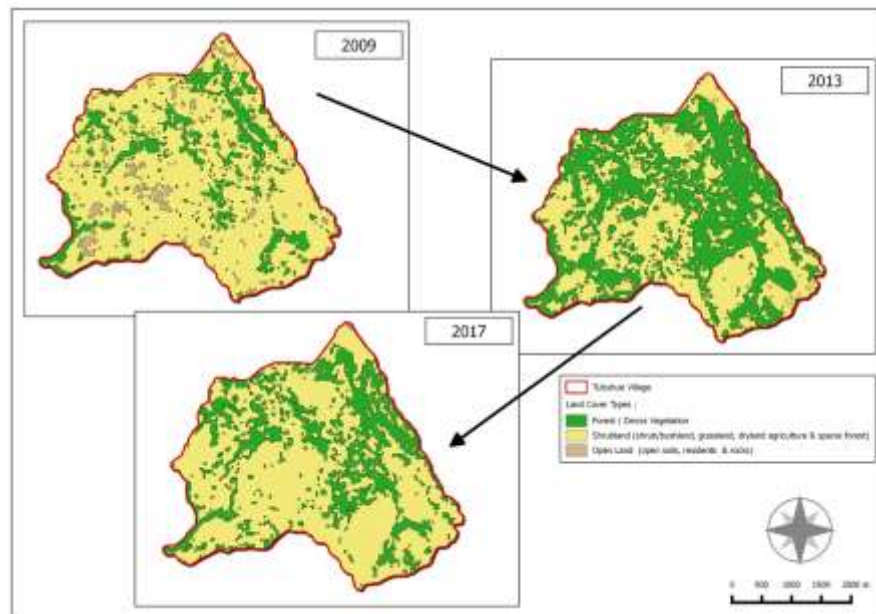


Figure 2. Land-cover condition of the year 2009, 2013, and 2017 indicating land-use change in Tubuhue village from prior to the beginning to the end of mining peak activities, and to present. (Source: Primary data, 2017)

The increasing area open land and shrub in the 2017 land cover indicated that swidden farming again regained its dominance. After the end of the mining boom, members of local communities returned to practicing swidden farming. Despite the fact that some ex-miners choose to organize themselves to farm at the former mining sites, the size of the site was not large enough to accommodate all ex-miners. In addition, the access to the former mining sites was not free for all of those formerly involved in mining activities in different sites. It involved negotiation with the traditional owner of the land where farming in the former mining site was located. Hence the only available alternative for the majority of the ex-miners was to go back to their former locations of swidden farming.

What is apparent from this analysis is that blaming artisanal small-scale manganese mining as causing environmental degradation is not fully justified. Because based on observation, in-depth interview and spatial analysis (Figure 2), swidden farmers had obtained a better income from mining, they abandoned swidden farming, allowing shrub to grow in their abandoned swiddens. Meanwhile, no other shrubs and forest areas needed to be opened for swidden. In combination, the abandonment of swidden land and no further clearing of shrubs and forest to open new swidden farming had contributed to the reduction of the areas of open land and the increase of shrub and forest land during 2009-2013. When the mining collapsed in 2012, most ex-miners returned to practice swidden farming by reclaiming their abandoned swidden or opening new one by clearing shrubs and forest, thereby increasing the area of open land and shrubs in 2017. Digging holes for mining could trigger soil erosion as pointed out by Riwu Kaho et al. [9], but the process could have been much slowed down by the growth of grasses and other vegetation within and around the mining site.

3.2. Social transformation

Land-use transformation taking place during and after the manganese mining boom in Tubuhue and in other villages in Noelmina Catchment linked to the social dynamics of local communities. Livelihood changes cause social change. Such social dynamics were evolved around efforts to survive a harsh physical environment characterised by infertile soil and dry climate. Soil in the region is mostly

limestone-derived and hence its fertility is generally low. The climate is characterized by a short wet period, usually by the West monsoon during December to March, and followed by a long dry months (Figure 3). In such a harsh environment, the focus of people in using the available land is to produce food enough for their own consumption. Large track of land is available, but there are issues of complicated land tenure, low soil fertility, and lack of rainfall that is intricately interconnected in causing low household food production leading to famines.

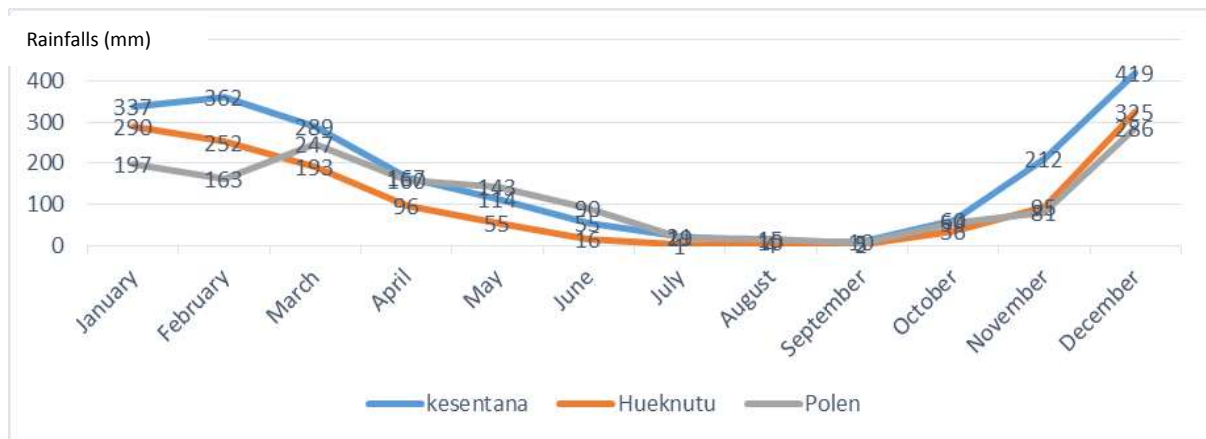


Figure 3. Monthly rainfalls based on the average of ten year data (January 2007 to December 2016) from Climatology Station of Lasiana-Kupang (Indonesia Agency for Meteorology, Climatological and Geophysics, BMKG)

Swidden agriculture had been practiced for generations without much change, despite government efforts to modernize agriculture [10]. Communal land tenure prevented long-term investment even for such an effort as simple as soil conservation because land that someone occupied for swidden in a particular year would not be necessarily available for the same person thereafter. Those involved in swidden farming by clearing and burning a particular track of land gained their access based on kinship relation and through negotiation with the clan that traditionally entitled to that track of land. Soil fertility was generally low, not simply because of the geological history of West Timor as an uplifted limestone sediment, but also because the pressure of continuous swidden practices that, because of population increase, allowed only a short fallow period barely enough for the soil to regain its fertility. In anticipation to low and unpredictable rainfalls, farmers relied on low-yielding crop varieties that survived the unpredictable rainfalls better than high-yielding varieties.

Swidden farmers in West Timor planted maize once a year during the rainy season by intercropping with other crops, usually with pulses and squash. From being cultivated for generations, maize, pulses, and squash had evolved to produce a large number of landraces adapted to dry condition. According to local farmers, the productivity of such landraces was much lower than that of the introduced varieties, but their capability to withstand drought was much better. Local farmers told us that they practiced intercropping both to maximize land productivity and to guarantee they still had other crop to harvest in case one crop failed. In addition, they also developed locally specific coping mechanisms such as collecting bee honey and tamarind pods from nearby shrubs or forest and also raised cattle, pig, and chicken that they could sell any time in case they need cash. They treated manganese mining initially as another form of this coping mechanism. However, since the income they obtained from the mining was much higher, then they spent most of their time for mining. Later they neglected and even abandoned their swidden crops and doing other coping mechanism activities.

When manganese mining reached its peak, income from mining reached IDR 500,000 to IDR 1,000,000 per week. This was a large sum of money according to the local standard, although according to Dara [1], this amount was just part of 2.8-3% shares of the world price of manganese ores

at that time. To local swidden farmers, however, this changed their life considerably. From the income they obtained from mining, they were able to pay tuition fees for their children, to rebuild their houses, and to pay other day-to-day household expenditure. Markus (2017) mention miners on the Neolmina Catchment area (included Tubuhue village), used their income for household needs (32%), children school fee (19%), donation to church/village (17%), house repairing (11%), furniture, jewelry, land, motorcycles (8%), farming tools (5%), bought Cattle (4%), and bridge well (4%). In Tubuhue, where manganese mining was organized by a local leader, the income from the mining was used to send children from the village to go to school in the district capital and to pay for tuition fees for those graduated from high schools to attend nursing college in the provincial capital. Similar benefits were also obtained from manganese mining on other villages as pointed out by Dara [1] as follows:

Most of the respondents highlighted that the mining activities have created an alternative livelihood for the local people, although they realize that the benefits are too small compared to time and efforts that have been spent on mining activities. The significance of the economic benefits derived from ASM activities can be identified by the changes in their capacity to fund their basic needs such as food, water and sanitation, adequate housing and basic education.

What then made the mining in Tubuhue different from those in other villages was leadership. In Tubuhue, the mining was organized by a charismatic local leader who was able to convince members of the local community to carefully plan mining sites, manage the marketing of the ores, and use part of the income from the mining for improving local public infrastructure. A church now standing magnificently in the village was built from the income of manganese mining contributed by miners.

That artisanal small-scale mining has a potential for driving local development has also been pointed out by Hilson [11]. However, he also highlighted several drawbacks that could arise, the most common one was land tenure conflict. Such land tenure conflict had killed one miner in a village in Kupang District. Another important issue associated with artisanal small-scale mining found during the conduct of this study, as also common in other locations and countries [2,12–14], was its legal status. All artisanal small-scale manganese mining sites in the district of South Central Timor was by law illegal because for reasons not clearly explained, the district government adopted a moratorium policy. Nevertheless, despite being illegal, the mining continued to take place [1,15]. In fact, it was this illegal status that allowed negative impacts to take place. On site gambling and prostitution, child abuse, unhealthy mining practices, smuggling, etc., had been reported of taking place in illegal mining sites [16,17]. Fortunately, those negative impacts did not arise in Tubuhue, thank to the charismatic local leader that had successfully organizing the miners in the village.

One important issue we worried about was whether those who have been involved in the mining for quite some time and earned easy money would be willing to return to farming. As we have discussed in the section about land-use transformation, it was true that shrubs and forest reclaimed the landscape of the village and this reclaiming could be associated with the decrease in swidden farming activities. However, as indicated by results of our interviews, those involved in the mining did not completely abandoned their swidden. As put forward by an ex-miner (MBS; anonymous), "doing swidden or mining is all about digging holes in the ground. The only difference between them is whether you dig to plant seeds or to remove rocks from the soil". Another ex-miner told us that they engaged in manganese mining simply to take an opportunity available for them to earn additional income to pay tuition fees, house improvement, and "to buy fish or chicken so we can eat better food". Base on good organisation practices for mining resulting in social transformation, from swidden farmers, mining, and the and there are ultimately intensive horticultural cultivation utilizes mining land.

3.3. Post-mining activities

When the price of manganese ores crashed in 2012, mining was no longer feasible. Those who had for a while enjoyed better income had to return to their previous real life. One ex miner told us that the period of mining boom was "like a sweet dream" and the crash of the boom "like a sweet dream turn

into a nightmare". Not only losing additional income, the ex-miners also faced stigmatization as causing environmental degradation from other community members who did not join mining activities (base on FGD and in-depth interview data). In fact, many people blamed artisanal small-scale mining as causing erosion and landslides, ignoring the fact that due to its geological history, the characteristic of soil in West Timor is intrinsically prone to erosion and that swidden has worsened this situation. Fortunate enough, ex-miners in Tubuhue had a local leader that they could turn to for advice.

The local leader was the one that had from the beginning organized miners in the village. When the mining collapsed, he asked ex-miners to voluntarily helped him to turn a number of big ex-mining holes into a check dam to collect rainwater and later to channel water from a spring nearby using propylene pipes (Figure 4A) and then leveling the ground around the check dam to plant vegetables (Figure 4B). "At the beginning only few ex-miners participated", the leader recalled, "but as our vegetable flourished and they saw us sold our produce in the market, more and more of them come to me asking to join". He then told us that he formed a farmer group consisting of those ex-miners who joined him in the business. As more and more ex-miners joining, he asked them to form two more farmer groups and to expand the farming area beyond the mining site. At the same time, because they needed to distribute the water from the check dam into a larger area, they developed a network of drip and sprinkler irrigation systems out of additional pipeline they laid out from a spring located above their farming site.

There they (farmers/ex-miners) planted different kinds of annual vegetable and fruit crops as well as and spices and herbs. "At the beginning we plant only 'sawiputih' (a cultivar of *Brassica rapa*)", an ex-miner member of the earliest farmer group told us, "but then we realized that we could get more profit from planting chilies". He continued telling us that because they planted at the right timing, "we harvested our chilies when the price was very high". From selling the harvest members of the groups were again able to have enough money to pay tuition fees for their children and to buy fish or chicken for their kid to eat better food. However, the price of chili pepper was very fluctuated, causing them to obtain a large profit from one harvest and from to lose money from another. It was from such an experience that they no longer relied on one crop. Instead, they planted different kind of vegetables, fruit, and spice crops either each in a separate block or intercropped two or more of them in one block (Figure 4C).



Figure 4. Land Rehabilitation and Agribusinesses activity at Tubuhue, A: The check dam constructed from mining holes, B: Leveling and preparing the ground around the check dam, and C: Annual vegetable and fruit crop and spices and herbs planted in various cropping patterns (Source: Researcher documentation, 2016)

The role of a local leader with a far-reaching vision is indispensable in the whole process of transformation taking place in Tubuhue. This local leader is the owner of the land where the mining took place during the booming period. Instead of asking those who mined in his land to pay him, he asked them to contribute a small portion of their income to pay the cost of the village church construction and the tuition fees of children he sent to high school and to nursing college. Similarly, he did not ask those who did the farming in the former mining site to pay him some money. "I am more than happy to see if someday more and more people in this village abandoned swidden and do

sedentary farming like what we do here", he explained. He continued by telling us that he had a dream that someday he could see more forest in his village. When we show and explain to him the map in Figure 2, he only said, "I wish the manganese boom were a bit longer".

4. Conclusion

Referring to our objectives in doing this case study and based on the results and discussion we have presented, we concluded that artisanal small-scale mining in Tubuhue has contributed to the dynamic of local land use and social-economic transformation. The organized artisanal small-scale mining and post-mining land rehabilitation practised in the village can be used as a model for solving rural poverty as well as for organising environmentally friendlier artisanal small-scale mining operations. The way the ex-miners turned their nightmare into a new opportunity by developing a flourishing horticultural farm in their former mining site could serve as way to convince swidden farmers to abandon their practices of clearing and burning a track of land every year.

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