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Managing the socio-economic impact of tin mining on Bangka Island, Indonesia – preparation for closure

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Abstract

Tin mines in the Bangka Belitung Islands have been exploited for about a hundred years. Following the issuance of a 1999 Ministry of Trade and Industry decree that tin is not an export item to be monitored and regulated, the Bangka regent issued a decree giving permission for the people to mine tin in 2001. Consequently, "unconventional mines" (tambang inkonvensional)*, the term used to describe local small-scale tin mines, have expanded significantly since 2000.*

Bangka Island has a surface of 11,900 km^2 and is mainly lowland below 50 m with some hills up to 700 m; climatic differences within the island are small. Its climate is hot and wet with an average annual rainfall of approximately 2,400 mm. Mining activities are spread across the island and run by one publicly listed tin mining company, dozens of private companies and thousands artisanal mining groups.

Tin mining activities increase the wealth of the people, but they decrease environmental stability. Offshore mining has reduced water quality as total soluble solids have increased and pH decreased; changes in the seabed have caused changes in benthic flora, fauna and plankton diversity and an increased mortality index of coral reefs and their associated fish. The number of fish caught in the offshore mining site has decreased. Inland mining activity has reduced soil fertility and flora and fauna diversity. Inland mining has reduced the number of individuals, species and plant families. In some areas, illegal mining causes floods in the rainy season and damages roads and bridges.

Socio-economic secondary data were collected from various sites on Bangka Island through a literature review. In addition to inadequate commitment and political will on the part of the local and national governments, a low level of law enforcement seems to be a dominant factor in the low environmental awareness. These findings may be used to accelerate the mine closure program started by the largest tin mining company. This paper illustrates some opportunities and alternatives.

1 Introduction

Bangka Belitung Islands produced approximately 106,000 t of tin in August 2013, representing more than one third of global tin supply (IDH, 2014). The majority is exported to Singapore, followed by Malaysia, Japan and the Netherlands. Tin mining is the most significant activity in the islands, taking place onshore and offshore, including in protected forests and marine ecosystems. There are between 15,000 and 50,000 artisanal mines and approximately 30 independent smelters (IDH, 2014).

Following the issuance of a 1999 Ministry of Trade and Industry decree (No. 146/MPP/Kep/4/Tahun 1999) that tin is not an export item to be monitored and regulated, the Bangka regent issued a decree (SK Bupati Bangka No. 6 Tahun 2001) giving permission for the people to mine tin in 2001. Previously, as a strategic or group "A" commodity, tin could be mined and marketed on by the public tin company. Consequently, "unconventional mines" (*tambang inkonvensional – TI*), the term used to describe artisanal and local small-scale tin mines, have expanded significantly since 2000. Tin mining has become a dominant economic driver in the islands, leaving pepper plantations behind (Zulkarnain et al., 2005).

There were 80 dredges and 3,600 floating tin mines off the shore of Bangka Island in 2013 (Bangka Pos, 2013). Tin production from artisanal mines contributes up to 80% of Indonesian tin exports, and tin mining activities

increase the wealth of the local people, but most of the activities neglect good mining practices, safety and land reclamation (ITRI, 2013). There were 80 mining-related casualties in 2012, and 22 in 2013 (Nurtjahya et al., 2014). Most accidents at inland mine sites are due to landslides, and non-standard diving devices are responsible for most deaths under water (Walhi – Friends of the Earth Indonesia, 2013).

The low level of law enforcement seems to be a dominant factor for low environmental awareness among people, operators and regulators. Without firm and consistent implementation of regulations, reclamation and revegetation measures and community development activities are meaningless and very inefficient. People's involvement and concerns are not genuine. It can be predicted that a mine closure program will fail, although a lot of money will be spent. Balancing internal and external pressures with socio-economic impacts would put law enforcement on the right track. The question then is how to manage these pressures to secure the mine closure process.

1.1 Site description

Bangka Island, with a population of 991,062, is located off the eastern coast of South Sumatra Island (BPS 2012). Bangka Island has a surface area of 11,900 km^2 and is mainly lowland below 50 m with some hills up to 700 m; climatic differences within the island are small. Its climate is hot and wet, belonging to the Af-type Köppen-Geiger climate classification (PT Timah Tbk., 1997), with an average temperature of 26.3°C, average humidity of 61.7% and average annual rainfall of approximately 2,400 mm.

The authors and their students gathered secondary data from sites in all four regencies in Bangka Island: Bangka, Central Bangka, West Bangka and South Bangka.

1.2 Soil degradation and inland biotas

Alluvial tin deposits – cassiterite (SnO_2) – were revealed after stripping the vegetation above the upper soil and removing the non-tin deposit overburden. Tin extraction is done by pouring a large volume of highly pressured water over the sediment, with the heavy tin ore separated from light material such as quartz by gravity in a series of jigs, shaking tables or traditional jigs (*sakan*). Non-tin sediment settles in a lower area with acidic pH that may go below 3.

Dredging is conducted to exploit tin deposits located offshore. Artisanal small-scale miners use small traditional gravel pumps to pump tin-ore deposits to floating dredge units (*TI apung*) or modified small fishing boats. Large dredging ships (*kapal keruk*) that can excavate tin ore at up to 70 m depth with bucket wheel dredging (BWD) and offshore suction boats (*kapal isap produksi*) are used to exploit the tin slurry and pump it to the concentrating plant. Gravity is used to separate the tin ore from other material. The alluvium is broken up by a high-pressure jet of water and suctioned to the concentrating plant above the water, changing the seabed and leaving high turbidity below the water surface.

Inland mining decreases soil properties, with soil texture changing from about 70% to 97% sand faction. The concentrations of phosphate, potassium and sodium in undisturbed land are higher than in disturbed areas, and are gradually decreasing as more tin-mined land is abandoned (Nurtjahya et al., 2009b). C-organics are less than 2%, and the cation-exchange capacity (CEC) of tin-mined lands is very low (0.4–3.9 units) (Nurtjahya et al., 2009b). The soil temperature may reach 45°C during the day (Nurtjahya et al., 2008c), and evaporation on sandy tailings may reach 4 L/m^2/day or double than of undisturbed soil (Nurtjahya, 2010). In mining activity, the water and the sediment from the washing process bring acidic material, which makes the catchment more acidic – with a pH below 3. Together with this material, lower pH negatively affects soil flora and fauna. The zero-year sandy tailings itself has pH of about 4.5–4.8. The pH is getting higher, up to 5.1 in an area with 38 years of natural regeneration. As a comparison, the pH of forest and abandoned farmland is around 4.5–4.7 (Nurtjahya et al., 2009b).

Mining activity changes the vegetation structure and composition. The vegetation structure after 38 years of natural succession on old tin-mined land was less than 2%, similar to that of a riparian forest on Bangka Island (Nurtjahya et al., 2009b). In the forest, there are 7,295 individuals per hectare of forest, belonging to 85 species and 44 families. An area with 38 years of natural succession on old tin-mined land has 2,180

individuals per hectare, belonging to 16 species and 13 families; and an area with seven years of natural succession on old tin-mined land has 890 individuals per hectare, belonging to six species and four families. After 38 years of natural succession on old tin-mined land, there is no record of poles (trees with diameter between 10 and 20 cm) or trees with a diameter of 20 cm or more. As a comparison, in an area of abandoned farmland, there are 7,175 individuals per hectare, belonging to 48 species and 47 families (Nurtjahya et al., 2009b). The number of arbuscular mycorrhizal fungi (AMF) spores increases with the abandonment of tin-mined land, and the number of phosphate solubilising bacteria (PSB) shows different readings with the period of abandonment (Nurtjahya et al. 2009b).

Land recovery and coral reef transplantation are costly. Excluding land function change from pepper plantation, the revenue from tin through land function change is lower than for non-mining land uses: protected forest, rubber plantation and beach (Nurtjahya et al., 2014). Cultivation on mined sites requires large input. The expenditure to convert one hectare of previously tin-mined site into rice field is estimated at Rp. 31 million, with the land preparation component representing the major portion (about 62%), and almost 50% of the costs are for physical and chemical soil property improvement (Nurtjahya et al., 2009a).

1.3 Water quality and off shore biotas

Offshore tin mining has reduced water quality. This is shown by a 40% total soluble solid (TSS) increase, a 75% sedimentation rate increase, a 25% water pH decrease (i.e. from 8.0 to 6.0, becoming more acidic) and a 50% dissolved oxygen (DO) increase (Nurtjahya et al., 2014). Wahyuni et al. (2013) reported that, owing to tin mining, the concentrations of lead (Pb) (0.223 ppm) and TSS in solution offshore at Batu Belubang (705 ppm) were above the ministerial regulations of (Kepmen LH No. 51 tahun 2004) 0.008 ppm and 400 ppm respectively, and it was normal to find cadmium (Cd) and zinc (Zn) in the water and Pb in sediment.

The increase of TSS affects the aquatic ecosystem, reducing oxygen supply (Mukhtasor, 2007) and changing photosynthetic processes in phytoplankton and aquatic plants. In another study, offshore mining was found to cause a 40% reduction of the number plankton species (Nurtjahya et al., 2008a). The number of species of seagrass in mined water was about 70% of the number in less mined water (Nurtjahya et al., 2008a). The dominant substrate in mined water was sand and rubble, in contrast to macroalga *Halimeda* sp. anemone in less mined water (Nurtjahya et al., 2008a). Seagrass specimens such as *Cymodocera rotundata*, *Cymodocea serrulata* and *Thallassia hemprichii* were reported in the water at Tukak Beach in South Bangka, whereas the majority of seagrass was dying in the water at Tanah Merah (Nurtjahya et al., 2014).

The Walhi – an environmental NGO – reported that tin mining was responsible for up to 90% of the damage to coral reefs and the reduction of coral reef–associated fish (Walhi, 2013). The number of coral reef–associated fish in mined water was 30% of that in less mined water (Nurtjahya et al. 2008b). Coral reef life coverage was less than 25% in mined water compared to more than 90% in less mined water (Nurtjahya et al., 2008a). However, the growth rate of the coral reef species *Acropora digitata* transplanted to Teluk Limau Beach, Bangka, was 2.2–2.4 mm/month (Sodikin, 2011).

Pratama (2014) reported that because of floating small-scale artisanal tin mining units (*TI apung*), the number of fish caught has decreased, causing some fishermen not to go fishing. In the past, when the condition of the coral reefs was much better, fishermen in one area could harvest up to five metric tonnes per day, fishing could be done 300 m to 1 km from the beach, whereas now the fishermen need to go 1.5–5 km with no guarantee of a good catch.

1.4 Tenurial claim

An agrarian problem has arisen since the start of mining, before the reclamation or revegetation of mined sites (FEM IPB, 2013). Two problems are identified: (1) the mobility of artisanal small-scale miners (TI and *tambang skala kecil*) in reclaimed sites cannot be controlled by the mining company, and (2) ownership claims related to and occupation of reclaimed sites. These problems may arise at any step of the reclamation process. During step 1, site determination, artisanal small-scale mining, or huts, or plantation crops suddenly exist in few days. During step 2, site preparation, artisanal small-scale mining and plantation claims arise.

During step 3, cover crop planting, artisanal small-scale mining, plantation claims and territorial claims arise. During step 4, revegetation, artisanal small-scale mining and territorial claims exist, and cover crops are tampered with. During step 5, maintenance, revegetation plants are stolen, cut or claimed, the area is re-mined or societal conflict exists (FEM IPB 2013).

As one mine site can be re-mined by different group of miners, soil quality decreases before reclamation (FEM IPB 2013). In the case of reclaimed and revegetated sites, illegal mining has destroyed the reclamation and revegetation process. Re-mining has financial consequences, as more input is needed for poorer soils. In many areas, the sites become an open access resource. In one location, the miners have land ownership issued by the local authority (FEM IPB 2013). From a survey conducted in 2012, only 23.6% of 2,111 hectares of potential reclamation area is eligible or free of claims by local people (FEM IPB, 2013).

2 Methodology

2.1 Data

Socio-economic secondary data were collected from various sites on Bangka Island through a literature review by the authors and some undergraduate students at Universitas Bangka Belitung. A descriptive qualitative method and purposive sampling were used, with 10-17 interviewees for each study. The interviewees are artisanal tin miners, artisanal tin mine owners, prominent local people, fishermen and former fishermen who has changed their profession to be floating TI tin miners.

2.2 Positive impacts

The positive impact of tin mining is economic (Juniarti, 2014; Indra, 2013; Romeo, 2011). The tin business brings in money in a short time; local people say the money earned from the tin business is "'hot money." Tin mining is considered the largest economic driver, making a significant contribution to the provincial economy. It is reported that about 10,000 artisanal small-scale miners support more than 50,000 people (ITRI, 2012). Artisanal small-scale mining contributes up to 80% of Indonesia's tin exports (ITRI, 2013).

The income percentage for tin miners compared to overall income per month of people in Lubuk Kelik, Bangka, is 93.4%; for ex-pepper farmers in Silip, Bangka, 95.1%; and for ex-rubber farmers in Bencah, Central Bangka, 89.1%. Pepper and rubber plantations contribute less than 2.3% each of overall monthly income of pepper farmers or rubber farmers (Nurtjahya et al., 2008b). The net monthly income of fishermen in Rebo and Bubus beaches, Bangka, is about one-third of the income of their colleagues working in tin mining (Nurtjahya et al., 2008a).

The majority of people in Bangka Belitung fall into wealthy categories as of 2011. The increase of income for the majority people is shown by the number of motorcycles and cars. From 1999 to 2011, motorcycle and car taxes increased 15-fold. The number of people who perform the hajj pilgrimage increased almost 10% from 2001 to 2012 (Erman, 2013).

2.3 Negative impacts

While tin mining increases income for miners or people active in mining, it also causes societal conflicts at mining sites. Most of the conflict in both inland and offshore mining is between locals and immigrants. Almost 60% of artisanal miners come from adjacent islands, such as mainland Sumatra and Java Island (Erman, 2013). Walhi – Friends of the Earth Indonesia (2013) reported 12 conflicts between local fishermen and miners between 2006 and 2011. Attitude changes and conflicts are reported in the hamlets and villages of the studied area (Table 1).

In terms of education, the drop-out rate from elementary to senior high school has increased. In 2011, the province of Bangka Belitung had the second-largest student drop-out rate in Indonesia because of children's involvement in mining or following their parents when they move to new mining sites (Erman, 2013.

In some areas, fishermen and farmers have changed their professions to become miners. Fishing boats are modified to become mobile floating dredges in Bangka (Nurtjahya et al., 2008a). Rubber plantations and pepper plantations have been mined in some areas in Central Bangka and South Bangka (Nurtjahya et al., 2008b).

Table 1 Attitude changes and conflicts because of artisanal tin mining in hamlets and villages

Aspect	Findings	References
Attitude changes	• Alcohol drinking, drunkenness, prostitution, gambling, drug use among male youth • Disobedience to parents • Consumerism • Neglecting prayer duties • Profession changes from fishermen to miners, from farmers to miners, from labourers to miners • Less collaboration among villagers	Iryanto (2014); Pratama (2014); Romeo (2011)
Conflicts	• Between café owners and local people, café owners and local women • Fighting over mining sites between different dredge-type miners, fishermen and artisanal miners, locals and immigrants • Between husbands and wives because of husbands buying the services of café hostesses • Between religious local culture and more secular immigrant culture • Over financial transparency between head of village and local people	Anggrewan (2012); Christina (2011); Juniarti (2014); Bangka Pos (2015)

Offshore mining affects the fish catch. Small pelagic and demersal fish production decreased at three offshore mined sites in three regencies over the period 2009–2010. At Batu Belubang Beach, Central Bangka, the total small pelagic fish production decreased more than 50% in the 2009–2010 period (Octarini, 2011). At Rebo beach, Bangka, small pelagic production decreased 10% and demersal fish catch decreased up to 48% in the period of 2007–2010 (Sucita, 2011). At Tanjung Ular beach, West Bangka, small pelagic production decreased 24% and demersal fish catch decreased up to 70% in the period of 1998–2008 (Bidayani, 2010). A river that receives tin sedimentation has 22 species and 10 families of fish, whereas a river free from tin mining has 36 species and 16 families of fish (Muslih et al., 2013).

The habitat changes have caused the benthic mollusc species *Laevistrombus canarium* L. (locally known as *siput gonggong*) of the family Strombidae to be replaced by the bivalve species *Anadara granosa* (Yulianda et al., 2009). The mollusc is the raw material of the most expensive seafood cracker in the province, up to Rp. 250,000 per kg or about US$ 25 per kg.

Flooding in many areas of the province is believed to be caused by tin mining. The original small stream channels have been changed by the mining activity. The changing channels cause flooding in many areas, and in one area flooding resulted in the loss of two lives in 2013.

2.4 Managing socio-economic impact

Socio-economic and cultural development is one of four mine closure programs stipulated by article 16 (2) d of the Ministry of Energy and Mineral Resources regulation for the Republic of Indonesia (Permen ESDM No. 7 Tahun, 2014). A number of social and economic indicators can be used in future surveys to measure the improvement as perceived by the local community.

Socio-economic impact must be managed to support the mine closure program in the province. To date, the only mining closure program is being conducted by the only publicly listed tin mining company. Socio-economic impact should be managed simultaneously by both internal and external stakeholders. Internal stakeholders implement the laws, socialise the laws to the people and work hand in hand to create alternative economic drivers after tin mining. External stakeholders such as the Tin Working Group (TWG) provide clarification of the tin supply chain to support the mining industry in becoming more sustainable. The IDH Tin Working Group works on mineral certification, although it started voluntarily. The local government may take the lead to educate and empower the local people by addressing the internal needs and external pressures in order to achieve sustainable development.

2.4.1 Internal needs

The broader group of stakeholders needs to consider the ecological cost of degraded mined soil for the sake of sustainable development in the province. Benefits should be passed on to future generations, not held by the current generation. Notably, more than 50% of mining money is sent outside of the province.

Regulators may play a role in enforcing good mining practices and issue rewards and punishments to miners as well as providing alternative non-tin economic drivers to the people. Law enforcement should be implemented fairly, and law the applied to everyone. Leadership, commitment and political will are required on the part of local and national legislators and executives. Every legislator and executive should have the same understanding of sustainable development. People should abide by the rule for the sake of their children and grandchildren. As the regulator, a Bangka Island regent invited a number of undergraduate students and skilled farmers from Java Island and the Sumatra mainland to change the mindset and educate local people about agriculture and livestock.

All mining laws (Peraturan Pemerintah Republik Indonesia Nomor 1 Tahun 2014, Undang-undang Nomor 4 Tahun 2009 tentang Pertambangan Mineral dan Batubara, dan PP Nomor 23 Tahun 2010 tentang Pelaksanaan Kegiatan Usaha Pertambangan Mineral dan Batubara, PP Nomor 24 Tahun 2012 tentang Perubahan Atas PP Nomor 23 Tahun 2010, PP Nomor 55 Tahun 2010 tentang Pembinaan dan Pengawasan Penyelenggaraan Usaha Pertambangan Mineral dan Batubara, PP Nomor 78 Tahun 2010 tentang Reklamasi dan Pasca Tambang) should be implemented. In many cases, especially in Bangka Belitung, the role of environmental NGOs is effectively to monitor the implementation of the law and trigger discussion among regulators and between regulators and legislators. Coverage in the local newspaper has given the local people more knowledge of the pros and cons of tin mining. One example is the issue of radioactivity in the mining industry. In the last two years, the international networking established by a local NGO has created pressure on local government to check on the implementation of the laws. Regardless how large the contribution, local and international NGOs invested in the International Tin Research Institute – ITRI Indonesia Tin Forum, an international seminar held in Pangkalpinang, Indonesia, in December 2013.

Academics should undertake research and development from a social approach to find economic ways of engaging in mine site reclamation and revegetation, find alternative economic drivers for the people and implementing the results of their research and patents. All of the work requires collaboration and integration from either regulators or business. In a previous study, the percentage of input to prepare mined land before it was ready to plant was almost 70%, or Rp. 22.8 million per hectare, with compost and mineral soils representing the two largest expenditures (Nurtjahya et al., 2009a). Corporate social responsibility (CSR) on the part of mining companies may support research, and at the same time create recognition of the companies themselves.

Operators, academics and regulators must find the best solution to implement the idea of people-based reclamation (FEM IPB, 2013) in practice. This is not an easy task. It is also about changing mindsets. However, involving students of all education levels may create positive results. Weekend camps and mandatory field involvement (*Kuliah Kerja Nyata*) for undergraduate students may be alternatives to educate people about sustainable development and sustainable mining.

Anyone can create environmental awareness. A university lecturer asked for support from the Pantai Rebo (Bangka Island) local authority and fishermen to conserve the offshore environment from inappropriate fishing and tin mining. Of 30 respondents, 64% agreed not to use bombs in their fishing, and 30% agreed not to mine in offshore water, while another 67% somewhat agreed (Umroh, 2015).

An effort should be made to change mindsets, although this requires a very long investment. Education is a potentially effective way to do this. Environmental awareness comes in many forms. Some local efforts includes the "Bina Cinta DAS" (loving watershed building) at the province's Balai Pengelolaan Daerah Aliran Sungai (BPDAS) for junior high-school students; mangrove planting in Belinyu, Bangka, by multiple stakeholders, including scouts; and mangrove nursery building at Rebo Beach, Bangka, by university students as their social project. A legal draft of watershed management principles has been prepared by a multisectoral forum and is in the process of becoming law.

2.4.2 External pressures

The international community may play an important role from outside the country. In the last couple of years, local, national and international environmental organisations have increased their campaigns against exported tin ingots produced using poor mining practices (Nurtjahya et al., 2014). Some foreign coverage in newspapers and short films has strengthened the call for good mining practices. A large newspaper in Europe published a story stating that it is highly likely smartphones contain a few grams of illegal Bangkanese tin (Hodal, 2012). This pressure led to the December 2013 Indonesia Tin Forum international seminar in Pangkalpinang, which made more stakeholders aware of the issues. It was also attended by some overseas smartphone company representatives and local and international consultants.

The TWG, which facilitated the seminar, identified that many of the sustainability issues are derived from the local and national operating environment and are not directly intrinsic to the business and practices of mineral exploitation and trade (IDH, 2013). However, the impact of tin mining on the biota is reported to be a concern for smartphone companies (Nurtjahya et al., 2014).

Thanks to the emerging EU regulation on due diligence in mineral supply chains, including for tin, there is increasing pressure from national and international NGOs and consumers for producers to supply tin using standard practices. Responsibly produced raw materials are becoming more important for mineral importers. Bangka and Belitung Island tin production has been associated with sustainability challenges. These include critical issues such as mining in protected areas and critical marine ecosystems, the lack of adequate rehabilitation practices, inadequate occupational health and safety measures and illegal artisanal small-scale mining (BGR, 2015).

A government body in Germany is concerned about good mining products and supports mineral producers to improve their social and environmental performance (BGR, 2015). As an advisory institution to the German government and partner authorities in the mining sector in developing countries, BGR will develop a practical certification framework to allow semi-industrial operations linked to the artisanal sector in particular to prove socially and environmentally sound mineral production and encourage their integration into the formal business sector (BGR, 2015). The framework consists of five basic principles: (1) traceability, (2) fair working conditions, (3) security and human rights, (4) community development and (5) care for the environment. At the same time, the framework presents a business opportunity for producers to meet international supply chain due diligence expectations for traceability and transparency (BGR, 2015). Volunteer tin producers/smelters could be audited by independent auditors based on the agreed standards (BGR, 2015).

2.4.3 Managing internal needs and external pressures

In the last few months, economic growth has slowed. Since 2014, law enforcement related to the tin mining business has been enhanced. The province should reduce its dependence on tin mining as the first step towards sustainable development (Tan et al., 2014). The local government may play an important role as a "conductor" to manage both internal needs and external pressures to hasten the process of achieving good mining practices and sustainable development. As of 2015, the authority for issuing mining licences is the governor, not the local government.

The community representation group (LKMTL) withdrew from the Kelian mine closure process in 2003 owing to some unaccommodated requests from the local community (Nyompe, 2003). Workers and the community prefer to air their grievances directly with the company because of a lack of confidence in the local government (McGuire, 2003). The community tried various means to press the company to meet their demands, including sending their grievances in writing to relevant authorities, the legal aid office and the National Commission for Human Rights, and holding a series of demonstrations (Nyompe, 2003).

The local government must provide more accurate recommendations to the provincial government for issuing mining licences. The local and provincial governments together may ask for a higher percentage of royalties and taxes. Collaborating with other stakeholders such as academics and NGOs, the governments should enhance efforts to educate people, that is, build awareness of the environment for all ages. Finding alternative economic drivers is also encouraged. Bringing in skilled agriculture labourers and livestock from neighbouring islands would accelerate the transfer of technology and agricultural culture to the local people. Undergraduate students and lecturers from other islands may support mindset changing and transfer some agricultural knowledge to locals. Tourism investments should be supported, in line with the efforts by the local Belitung Island government. External influences should be considered motivation. Implementing legal and sustainable tin supply chains and all aspects of an international audit would increase operators' and local people's compliance with the regulation, and therefore support sustainable mining and sustainable development. Local and international environmental NGOs may become good partners in monitoring and evaluating. Their recommendations are needed.

The increase of environmental awareness to empower local people to do business in sectors other than mining; better cooperation between the local, provincial and central governments on royalties and taxes; and more contributions from other stakeholders may pave the way to mine closure. Local entrepreneurship is enhanced in the mine closure process (Permen ESDM No. 7 Tahun, 2014). The local government should increase the likelihood of establishing sustainable benefits for people beyond mine closure. The only mine closure program has just been started by a state mine company.

Managing internal needs, external pressures and socio-economic impacts will put law enforcement on the right track. Correct law enforcement would support and secure the development of socio-economic and cultural programs. Clearly, socio-economic and cultural development is just one of many mine closure attributes. Socio-economic and cultural programs, however, would significantly contribute to the success of mine closure programs in Bangka Belitung.

3 Conclusions

The local government may play an important role in managing internal needs and external pressures to hasten the process of implementing good mining practices and sustainable development. The local government together with the provincial government may ask for a higher percentage of royalties and taxes. Collaborating with other stakeholders, such as academics and NGOs, education – that is, building awareness environment – should be enhanced for all ages. Finding alternative economic drivers is also encouraged. Tourism investment should be supported. External influences should be considered as motivation. Implementing legal and sustainable tin supply chains and all aspects of international audit would increase operators' and local people's compliance with the regulations, and therefore support sustainable mining and sustainable development. Local and international environmental NGOs may become good partners for monitoring and evaluation.

The increase of environmental awareness; empowering local people to do business in sectors other than mining; better cooperation between local, provincial and central governments on royalties and taxes; and more contributions from other stakeholders may pave the way to mine closure.

Correct law enforcement would support and secure the development of socio-economic and cultural programs. The success of that development would provide strong a basis for the success of mine closure in the province.

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