

## **A MODEL OF POST-MINED LAND RECLAMATION FOR POVERTY ALLEVIATION: A CASE STUDY IN COAL MINING OF SOUTH SUMATERA**

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### **Abstract**

Mining has been known as an important industry to accelerate economic development all around the world. Although the mining company has a responsibility to reduce poverty of people living near the mine location through a corporate social responsibility (CSR) program, poverty alleviation always depends on the effectiveness of community development activities. The land-based activities of the community often decrease due to a loss of agricultural land for mining purposes. A coal mining in South Sumatera, Indonesia, occupies thousands of hectares of previously forest and agricultural land, shifting more occupations into mining-related works. Questions then arise from the poverty issues that will be experienced by the neighbouring community when mine is closed in about two or three decades since the function of post-mined land will degrade significantly. This paper offers a sustainable model of post-mined land reclamation therefore the poverty probably resulted from mine closure can be alleviated. The model consists of reclamation strategy especially designed for development of income-generating programs for the community near mine location such as Forest Park (*Taman Hutan Raya*), Urban Forest (*Hutan Kota*), Plantation of Rubber and Palm Oil, and Arable Farming for food production.

*Keywords: post-mined land, reclamation, TAHURA, urban forest, poverty alleviation.*

### **Introduction**

The exploration of natural resources theoretically aims to gain economic benefits to support the development of a nation or region, especially in developing countries in which the quality of human resources is limited. Regency of Muara Enim, South Sumatera, Indonesia is an area containing various mine deposits such as oil, gas and coal. The mining sector of development supplies about a half of regency budget with a value of more than seven hundred billion rupiahs or about eighty million US dollars. Among mining activities in Muara Enim Regency, coal mining becomes dominant since oil resources drain out in the last few decades. The coal mining corporation in Muara Enim is a State-Owned Corporation (*Badan Usaha Milik Negara*), namely PT. Bukit Asam, therefore its responsibility includes economic and social aspects. The corporation occupies more than ten thousands of hectares of previously forest and agricultural land in Muara Enim Regency, causing a shortage of arable land availability for surrounding society.

While mining of coal is essential to the national and regional economy in Indonesia, it causes drastic soil and ecosystem disturbances, leading to severe soil and environmental degradation. Leaving land uncovered during mining and post-mining processes may result in several disturbances such as landslides, mudslides, water erosion, flooding, salinization, and pollution of downstream waters with heavy metals and chemical spills (Hermawan, 2011). Land topography, geologic material, and depth to the coal deposit determine the choice of mining method, whether surface or underground method. Surface coal mining method applied in South Sumatera consists of removing the vegetation and excavating the earth's surface until the coal deposit is reached. In general, surface mining has a more severe impact on soil degradation than

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underground mining due to drastic changes on the landscape geomorphology, natural vegetation, soil profile development, soil hydrology, and ecosystem function (Blanco and Lal, 2008). The surface coal mine operations generate large amounts of overburden material to gain access to the desired depths. The extent of soil degradation by surface coal mining depends on the amount of soil removed or excavated, type of minerals, topography, and climate.

Coal mining needs a proper management strategy in order to optimize the economic benefits without leaving degraded and less valuable post-mined land when the corporation is closed. Regency of Muara Enim has unfortunate experiences in receiving degraded land when oil mining is closed in the last 20<sup>th</sup> century, therefore the neighbouring community fell into poverty. This is caused by improper management strategy of mine closure planning especially in preparing post-mined land management to support non-mining economic activities following the closure. Since the coal mining will operate until 2040 or later, the coal mining corporation of PT. Bukit Asam has developed several concepts of post-mined land reclamation to ensure the sustainability of economic development in neighbouring valleys in Muara Enim Regency. This article aims to evaluate the concepts and use them as a poverty-alleviating model for reclamation of post-mined land.

## A PROPOSED MODEL

The Government Regulation of the Republic of Indonesia Nomor 76 (2008) requires reclamation and rehabilitation of critical lands in order to gain their functions for productivity. Among the critical lands need to reclaim and to rehabilitate is the post-mined land, because it covers a large number of critical lands in Indonesia. In South Sumatera, some post-mined lands that have major attention from the government are those of coal and oil mining in Muara Enim, Lahat and Musi Banyu Asin Regencies. However, the requirement of post-mined land reclamation as regulated in the Government Regulation Nomor 76 (2008) just include the reforestation of the land without any specific model of economic sustainability for people living near the location. The reclaimed land handed over by the mining corporation can be approved by the government when the coverage areal of revegetation more than 80 percent of the total area of post-mined land (Regulation of Ministry of Forestry Nomor 60, 2009). In other words, the success of reclamation of post-mined lands is indicated by the area that has been covered by reclamation vegetation without considering types and economic values of vegetation. In order to alleviate poverty, the post-mined lands need so called a “reclamation plus” strategy.

The Government of Muara Enim Regency issues two regulations regarding “reclamation plus” strategy in the post-mined management of coal mining lands of PT. Bukit Asam in Muara Enim area. The terminology of reclamation plus means the reclamation include not only revegetation activities, but also design, layout and types of vegetaiton to grow in order to provide economic values of reclamation activities such as natural and artificial recreation and non-woody products (fruits and latex). The first regulation is the use of post-mined lands for Forest Park (*Taman Hutan Raya, TAHURA*), as mentioned in Regulation of Muara Enim Regency Nomor 4 (2004). However, the decision of TAHURA itself can be made when the mining corporation ends by 2040 or later, because the legal status of TAHURA cannot be issued as long as the mining corporation still operates. Activities prior to mine closure include reclamation and rehabilitation of post-mined land in such a way for the preparation of TAHURA development. Design, layout and vegetaiton types are prepared in a general planning document called master plan as well as a detail design of post-mined land reclamation towards development of TAHURA. The area of proposed TAHURA is 5.640 ha and located between two major cities of Muara Enim and Tanjung Enim (Figure 1).

The second regulation is the Decision of Muara Enim Regent Nomor 550/KPTS/HUT/2011, 29 Augusts 2011 about the location and area of Urban Forest in Muara Enim Regency. The location assigned for Urban Forest development covers area of 50 ha in the post-mined land, located between the active coal mining area of PT. Bukit Asam and the city of Muara Enim (Figure 2). The type of Urban Forest to develop in this area is a combination of recreational and sperm plasma types. Therefore, the development of Urban Forest in the post-mined land in Muara Enim Regency has two main objectives, i.e. to provide a forest-based recreation area for economic purposes as well as to conserve typical sperm plasma usually found in the area of Muara Enim Regency.

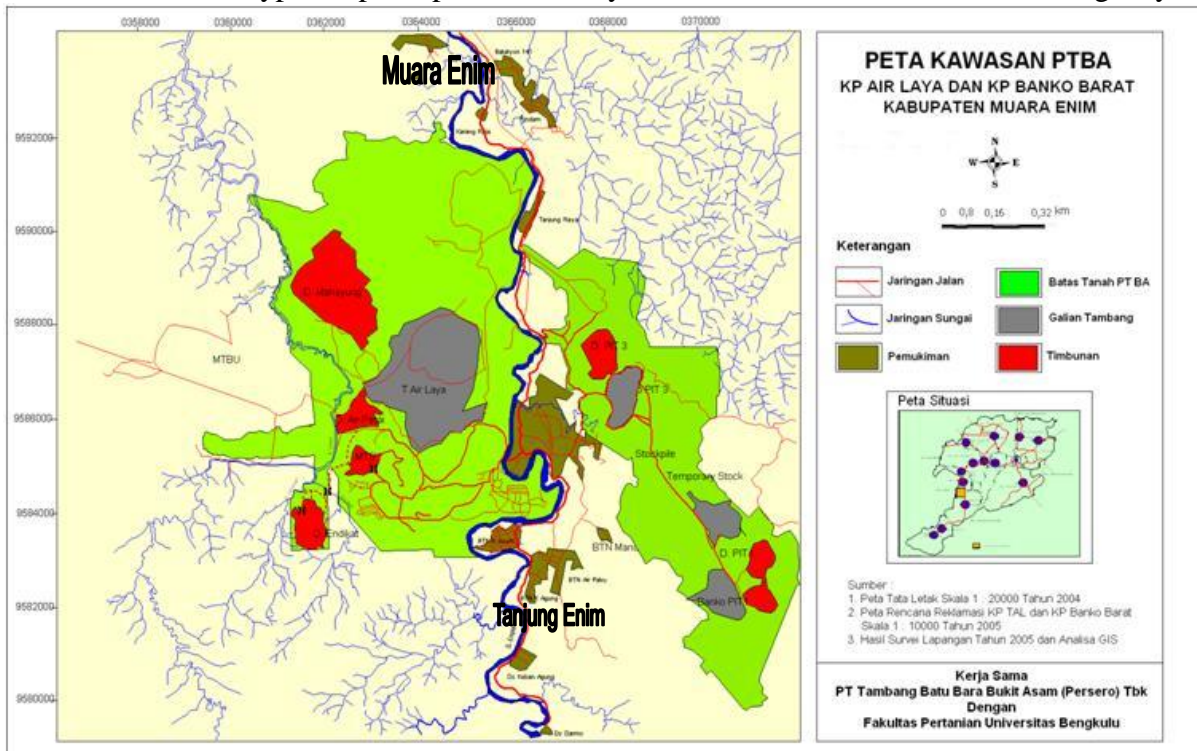


Figure 1. Location of post-mined lands proposed for TAHURA development

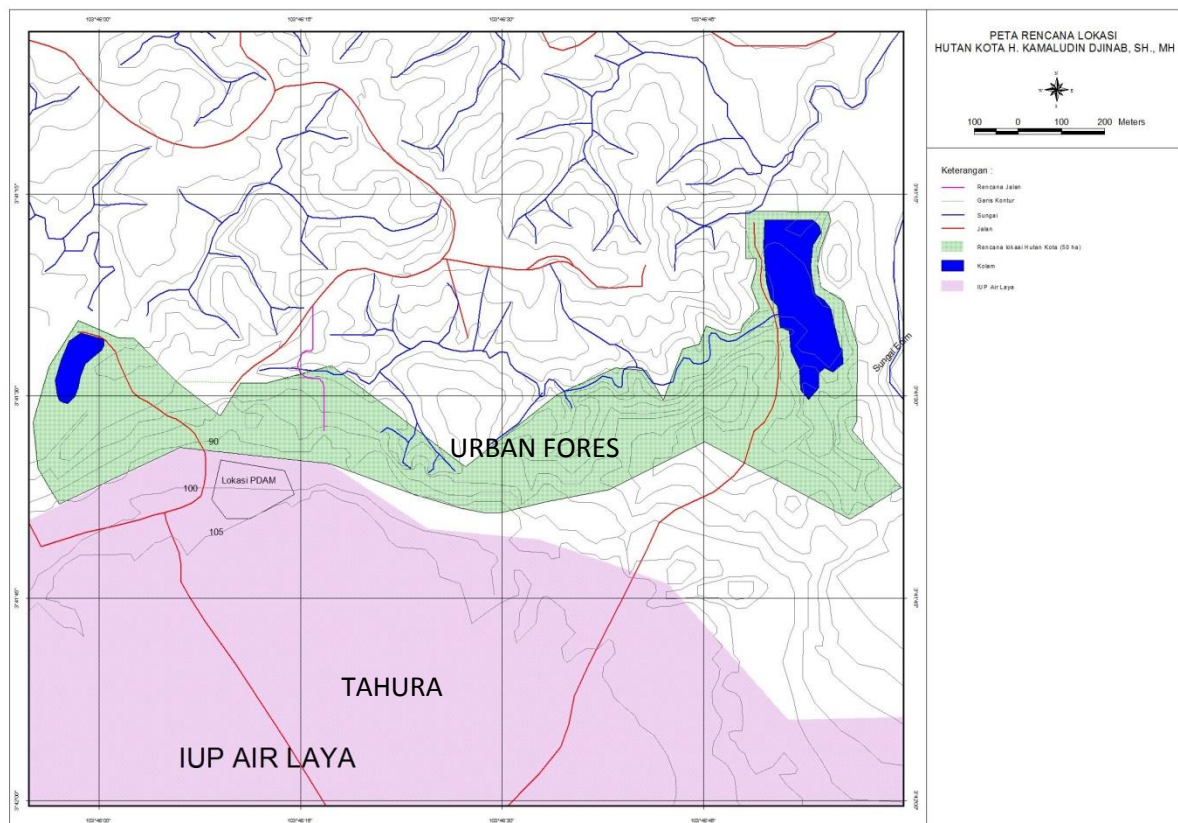


Figure 2. Location of post-mined land proposed for Urban Forest development

The proposed model as described above is called “post-mining reclamation and intensification for community economic sustainability” or PRICES Model. The reclamation-plus model includes the regular reclamation activities as mentioned in Regulation of Ministry of Forestry Nomor 60, 2009, plus intensive inputs in relation to design, types of vegetation and estetic aspects of reclamation sites. Design of reclamation site focuses on the layout of blocks or zona representing the function of the location, types of vegetaion are chosen on the basis of economic and environmental values, while estetic aspects are required to invite visitors to the site. In Muara Enim Regency, the PRICES model will be implemented in three action plans, i.e. multi-approach reclamation techniques followed by development of TAHURA and Urban Forest.

#### HOW THE MODEL ALLEVIATES POVERTY?

The prediction of fluctuative per capita income of the community prior, during and after mining activities is shown in Figure 3. During a period of the coal mining is operating, the community near the mining location may get economical benefits from the mining activities due to the field availability of works, small bussiness development related to mining, and a cooperation social responsibility (CSR) program delivered by the corporation (Raden *et al.*, 2010). Since mining activities also degrade land resources drastically, whether post-mining management will result in positive or negatif impacts on the economic condition of the local community depends on how the corporation prepares the planning and design to reclaim the post-mine land. Under conventional methods of reclaiming drastically degradaed post-mined land, the per capita income of the local community may fall into a critical poverty line following the closure of coal mining in 2040 or later. The loss of nutrient-rich layers of soil during mining operations leaves the poor and less produtvive land for agriculture, hence less opportunity for people to use the land for land-related economic activities.

Figure 3 shows that when the PRICES model is implemented in reclaiming post-mined land, the per capita income of the local community increases consistently although the mining activities already closed. The predicted per capita income is about Rp. 4.500.000,- per year, equals to Rp. 375.000,- per month or about US\$ 40 per month, the predicted per capita income is higher than the Indonesian limiting poverty income of about Rp. 180.000,- per capita per month (BPS, 2005). The questions then arise *how the proposed model can afford to increase the community income?*

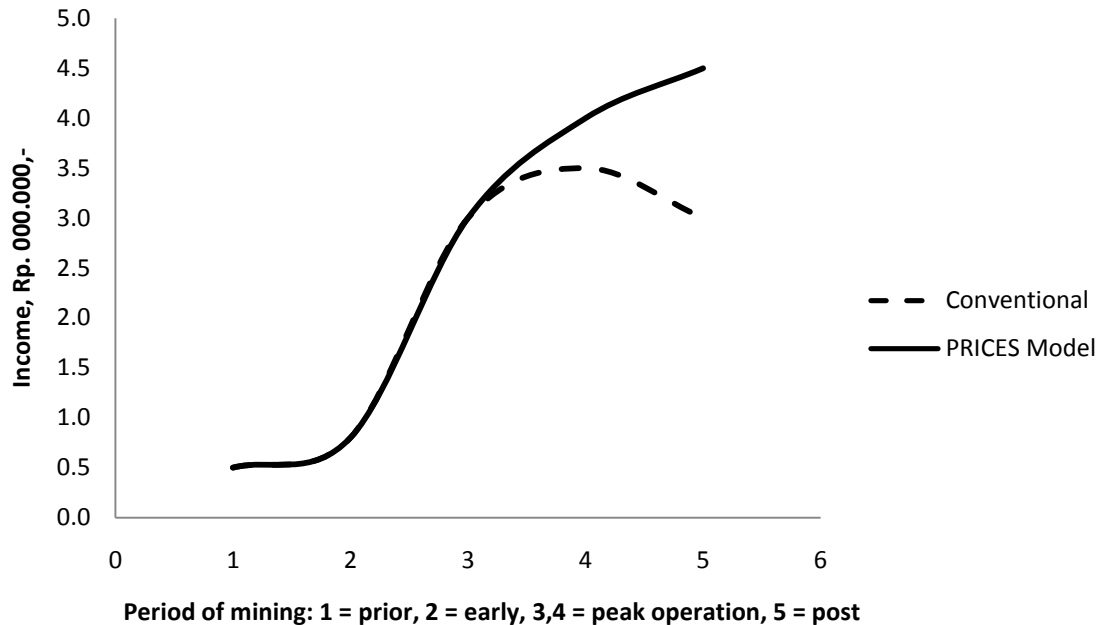


Figure 3. Prediction of per capita income of the community living near the mine location following conventional and proposed PRICES model of reclamation. Data source: PTBA (2011)

Reclaiming post-mined soils cannot be conducted by simply growing trees as usually applied by mine corporations. Reclaimed minelands could act as carbon sinks, but shallow soil, nutrient deficiency, and compaction could limit carbon accretion and crop growth in these ecosystems. In the PRICES Model, the planting technique will be modified by enlarging the planting holes to about 100 x 100 cm and creating bor holes at the bottom of planting holes to a depth of 50 to 100 cm. This technique aims to increase organic carbon at a deeper layer, especially when the holes are filled with topsoil or organic matter, and to ensure faster growth of roots within modified rooting zone compared to the conventional techniques. A topsoil application technique on the surface post-mined soil can promote tree growth and productivity significantly leading to increased organic carbon storage in the soil (Jacinthe and Lal, 2007). Our study shows that naturally growing pioneer crops such as *Cyperus* sp, *Mimosa invisa*, *Imperata cylindrica*, *Passiflora latifolia* and *Curculigo latifolia* improve post-mined soil quality better than reclamation trees (Hermawan and Hindarto, 2011), therefore these pioneer crops will be recommended in the model. Abundant microbial populations can be used as an indicator of reclamation practices and is likely governed by soil abiotic properties and, indirectly, by the effects of reclamation on plant growth (Dimitriu *et al.*, 2010).

The implementation of PRICES Model by developing TAHURA will cover area of 5.640 ha and located in Air Laya and Banko Barat mining operation sites as shown in Figure 4. Location of TAHURA is divided into three blocks of conservation, collection and utilisation respectively (PTBA, 2011a). The conservation and collection blocks can be planted with various adaptive tree crops to post-mined lands in the study area such as *jambu mete*, *kemiri*, *sukun*, *nangka*, *bambu*, *mahoni*, *johar*, *mindy* and *mangium* as have been reported earlier by Yustika and Tala'ohu (2006).

The utilisation block can be planted with tree crops as in the first two blocks and with cash crops such as soybean, corn, cassava and *kacang tunggak*. This block is also prepared for livestock and fishery development as well as for recreational activities including camping ground and water recreation. Livestock is a promising commodity to develop by the community in post-mined land (Purwantari, 2007). Ministry of Agriculture of the Republik of Indonesia has recommended the use of non-productive lands including post-mined lands for food security and biofuel development as reported by Ritung (2010). These all actions provide sustainable economic sources for the neighbouring community when mine is closed. The community can take parts in these actions as workers, small businessmen and other TAHURA-related activities capable of increasing per capita income.



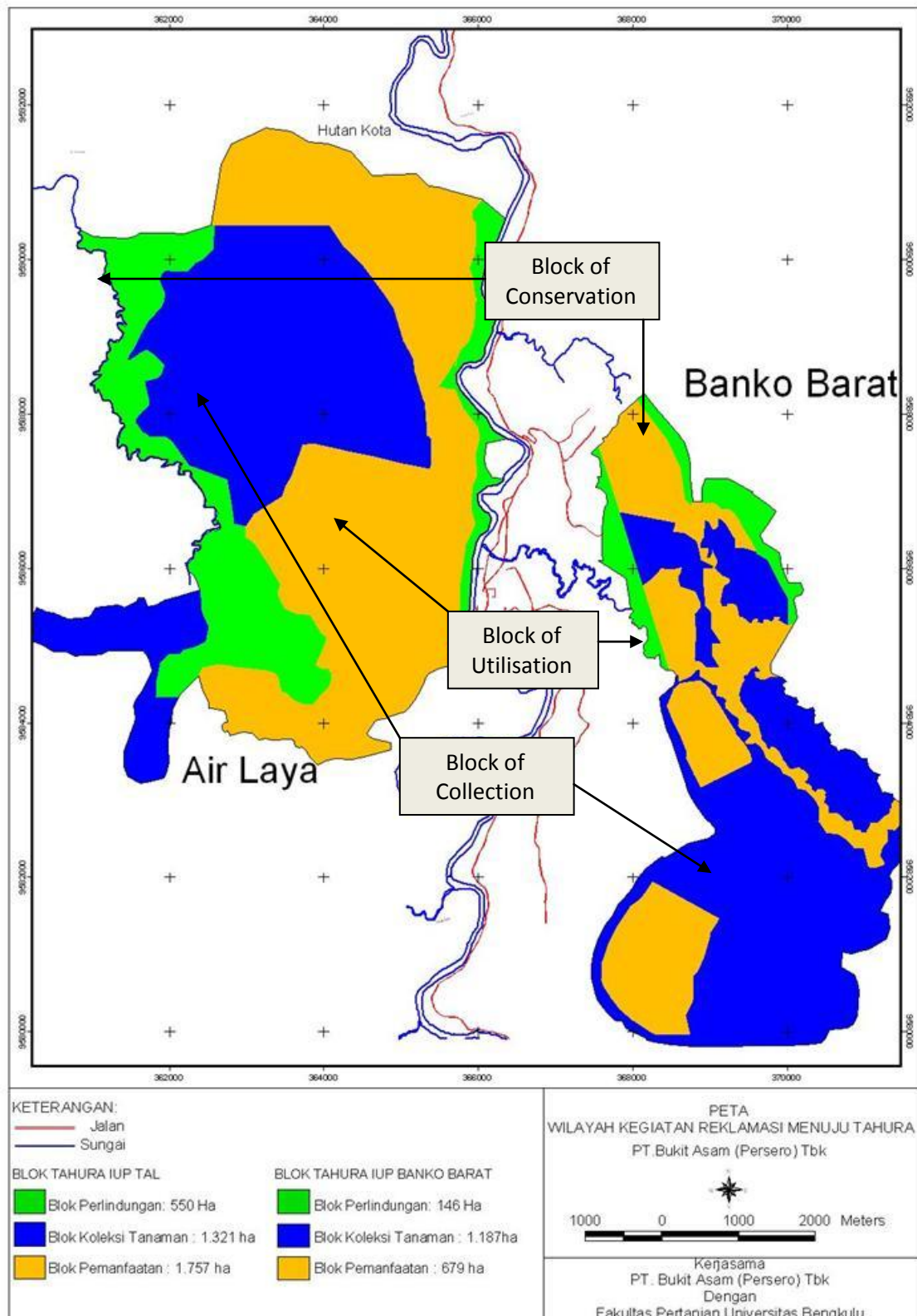


Figure 4. Dividing TAHURA area into conservation, collection and utilisation blocks for effective management system in alleviating poverty following the mine closure (PTBA, 2011a)

Urban Forest developed in the post-mined land, on the other hand, offers economic values directly and indirectly to the community. Harnik and Welle (2009) summarize at least five

economic values can be received by the community through the development of Urban Forest. First, at least 5 percent increase in the value of property located within 500 meter in distance from Urban Forest. Second, an increase number of visitors coming to Urban Forest will result in economic value from the entry tickets and other attractions. Third, direct uses of Urban Forest by the community for sports and recreation therefore the economic value is in the form saving by the community. Fourth, economic saving is also received by the community since Urban Forest offers fresh and pollutant-free air as well as comfortable temperature for keeping people healthy. Fifth, social activities usually take place in Urban Forest, some of which related to the maintenance of the location resulting in saving for regular maintenance of Urban Forest. In term of Urban Forest in Muara Enim Regency, these economic values will be achieved by offering some recreational objects such as water park, artificial lakes, outdoor sport facilities, camping ground, and recreational forest as shown in Figure 5 (PTBA, 2012).



Figure 5. Site plan of Urban Forest in post-mined land in Muara Enim Regency (PTBA, 2012)



## Conclusions

A model for post-mining reclamation and intensification for community economic sustainability (PRICES) has been developed in some coal mining sites in Muara Enim Regency, South Sumatera, Indonesia. Three components of the model are a multi-approach reclamation strategy (including modification of planting technique, topsoil application and the use of naturally growing pioneer crops), followed by post-mined land utilisation as Forest Park (TAHURA) and Urban Forest. We believe that the application of the model will increase the community welfare, while the conventional reclamation may lower their income to a limit of poverty line when the coal mining is closed by 2040. Restoration of post-mined land productivity by applying modified reclamation strategy, and income-generating activities created in TAHURA and Urban Forest will provide various fields of work to the community.

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