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Review

Increasing cocoa productivity and farmer capacity in surrounding area of PT Kaltim Prima Coal and PT Berau Coal

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Abstract: Based on agro-climate factors, most of surrounding area of coal mining sites in Indonesia is suitable for cocoa cultivation. However, most of cocoa farmers in the environs of coal mining sites have little access both to new technology of cocoa cultivation and to market of their cocoa products. Therefore, productivity of cocoa farms and the income of cocoa farmers are low, which may disturb social responsibility of the coal mining companies present in their surroundings. These are the consequences of poor interaction between the government, private sector and research sector. The aim of this study is to transfer and to implement good agricultural practices of cocoa in surrounding area of mining sites of Kaltim Prima Coal (KPC) and Berau Coal (BC), East Kalimantan, in order to increase farmer capacity and cocoa productivity. Indonesian Coffee and Cocoa Research Institute as the developing agent of cocoa technology has established collaboration with corporate social responsibility program of KPC (already 7 years) and BC (already 2 years) to improve productivity and farmer capacity of cocoa farms surroundings the two cocoa mining companies. This paper discusses the aspects of natural, economic and human resources; baseline study; technology transfers; marketing partnership; cocoa productivity; farmer income after technology implementing; study of cocoa growth on post-coal-mining. It is concluded that improvement of the cocoa productivity and farmer capacity surroundings the two mining sites associated with high adoption of technology by farmers, better access to availability of knowledge for good agricultural practices, extension officers, demonstration plots, cocoa price, and length of market chains, partnership, and competition with oil palm plantations.

Keywords*: coal mining, cocoa, collaboration, corporate social responsibility, technology transfer*

Introduction

Cocoa of smallholders has contributed significant benefit to the welfare of cocoa farmers surrounding the coal mining area of PT Kaltim Prima Coal (KPC) in Kutai Timur Regency and PT Berau Coal (BC) in Berau Regency. Area of cocoa farms close to mining sites in both districts in 2002 may reach up to 5700 ha managed by 2800 farmer families, while the cocoa business may support 3000 families which may cover cocoa collectors/traders and agents of fertilizers and pesticides. Productivity of cocoa farms in that area is considered relatively low, 400-500 kg/ha/yr, on the other hand, current potential productivity may reach up to 2000 kg/ha/yr. The big gaps between potential and reality in production may be due to external and internal factors of farm management. External factors include the attack of pests and diseases, old trees, absence of shade trees, and unavailability of fertilizers and pesticides. Meanwhile, internal factors include lack of knowledge concerning good agricultural practices of cocoa husbandry and absence of quick and continue technology information transfer.

As coal mining companies concern to environmental and social community aspects, PT Kaltim Prima Coal and PT Berau Coal have a Community Development Division which may develop a program to guide those cocoa farmers surrounding the mining sites (KPC, 2010). One of the main objectives of the community development plan is to focus on the sustainability of communities once the mining operations are closed. A significant aspect of the company's livelihood focus is the establishment of alternative

and sustainable livelihood programs. The purpose of this approach is to reduce the communities' economic dependence on the mine, and develop alternative and sustainable employment opportunities for stakeholder communities. The company has employed an alternative livelihood expert and projects have been set up in consultation with communities and regional governmental agencies, and practical training and initial material support have also been provided. A variety of livelihood program have been developed thus far, including farming of cocoa, citrus, and improved cultivation methods for food and estate crops. Therefore, the company asserts that they now hold monthly meetings with community leaders and representatives of adjacent communities, as well as attend all district assembly planning committee meetings. Also the company has recently signed a new initiative in Indonesia which aims to establish a new era in mining that is responsive to the needs of communities and to promote best practice in areas such as human rights and community development (Hilson, 2002). The fact that the company is beginning to consider the sustainability of community projects represents a step forward compared with the company's previous community development work; however, there are still significant drawbacks with their approach. Focusing on building physical structures, rather than developing the social capability of communities, is likely to increase the communities' dependence on the company.

As highlighted earlier, weaknesses in their consultation method suggests it is doubtful whether the whole community were consulted and thus only the demands of 'key individuals' (who do not necessarily represent the community as a whole) will be heard. More alarming is the tokenistic element of this strategy; using community development as an opportunity to showcase the company's commitment to CSR does not represent an approach that will benefit the community in the long-term, but resembles a public relations act (Jenkins, 2004).

It is arguable whether mining companies are best placed to decide what's best for the community, what will build social capital and what will deliver long-term sustainable development (Ite, 2005). CSR schemes are designed to suit corporate objectives and align with the business case very well, but this causes a scenario of dependency rather than helping the community to help itself (Frynas, 2005).

The company needs to act in the best interest of the community. CSR does not of itself solve the negative impacts of the mining industry on the environment, society, economy and local and national governance (Kapelus, 2002). Companies should not be put in the position where they take on a developmental role that should be provided by the government – they should work in partnership with the government and local agencies.

Natural, Economic and Human Resources

Cocoa of smallholders has contributed significant benefit to the welfare of cocoa farmers surrounding the coal mining area of PT Kaltim Prima Coal (KPC) in Kutai Timur Regency and PT Berau Coal (BC) in Berau Regency. Closed mining area cocoa farms in both districts may reach up to 5700 ha managed by 2800 farmer families, while the cocoa business may support 3000 families which may cover cocoa collectors/traders and agents of fertilizers and pesticides.

At present, productivity of cocoa farms in that area is considered relatively low, 400-500 kg/ha/yr, on the other hand, current potential productivity may reach up to 2000 kg/ha/yr. The big gaps between potential and reality in production may be due to external and internal factors of farm management. External factors include the attack of pests and diseases, old trees, absence of shade trees, and unavailability of fertilizers and pesticides. Meanwhile, internal factors include lack of knowledge concerning good agricultural practices of cocoa husbandry, low soil fertility and absence of quick and continue technology information transfer. Chemical characteristics of soil in the area of visitor plot are presented in Table 1 which showed that the status of most of essential nutrients in general was low, except Ca and Mg were high, whereas C and Fe were moderate.

As coal mining companies concern to environmental and social community aspects, PT Kaltim Prima Coal and PT Berau Coal have a Community Development Division which may develop a program to guide those cocoa farmers surrounding the mining sites. There was a suppressing of oil palm expansion on this area and there will be possibility of conversion of cocoa to oil palm. Therefore there is a need for having a data on distribution of cocoa area in mining site community. By having this, the Regent of this area may protect cocoa farmers by maintaining the presence of cocoa farms of small holders, beside guidance of mining companies and ICCRI. According to many experiences, cocoa husbandry is suitable for farmers having small acreage of land. Farmers supported by KPC have enjoyed

the benefit of the presence of cocoa farms as their significant income source. Nonetheless, dependence level of the farmers on the help of KPC is relatively big, because autonomy of the farmers is still small.

Table 1. Chemical characteristics of soil in the area of visitor plot in Sangatta Selatan

Nutrient	Level	Nutrient	Level
C	Moderate	Mn	Low
N	Low	Fe	Moderate
K	Low	Zn	Low
Ca	High	SO_4	Low
P_2O_5	Low	pH	Low
Cu	Low	CEC	Low
Mg	High	BS	High

Baseline Study

Most of cocoa trees in these areas were planted around 1990s where the seeds derived from Sulawesi. Cocoa planters are dominant from Bugis ethnic where they got their cocoa seeds from their family in this island. Cocoa trees are planted in home yard in which ownership of land about 2 ha per family. Farms of cocoa plants are found in flat areas of both sides of Kalimantan trans-road between Sangatta-Bontang, while the distance from seaside about 3 km. Soil type is alluvial clay in texture. Drainage was bad to moderate, soil depth more than 1 m, however the water table is deep. Based on rainfall data collected from close meteorology station the climate type was A (based on Schmidt-Ferguson classification) with Q value 0.132 and average rainfall was 2047 mm/yr. Dry months was commonly happened between July-September.

Planting distance of cocoa trees was 3 m x 3 m with shade trees of bananas (most common), *Gliricia sepium*, coconut, and various fruit trees. Growth of shade trees was vigorous, especially banana, where they are tolerant to wet condition. Until now, banana is the main source of income for the farmers.

In the last three years, cocoa growth was not vigorous with damaged tree canopy. At the beginning, cocoa was the main income source for farmers where the productivity was about 300 kg/ha, however, in year 2001 the productivity was only less than 50 kg/ha. Since 1999, it was reported that harvested cocoa pods were hardened. This condition enforced the farmers to turn to other crops, such as pepper, paddy rice, vegetables and bananas fruits as sources of income.

Based on field identification, it was found that the problems faced by cocoa farmers in the surrounding mining area were the attack of cocoa pod borer (*Conopomorpha cramerella*) with quite intensive

Technology Transfers

A number of technologies provided to cocoa farmers surroundings of the mining areas, among of them were management of *Gliricidia sepium* as shade trees, cocoa pruning, sanitation of cocoa pod husks and pod sleeving for suppressing the attack of cocoa pod borer, fermentation and drying of cocoa beans.

Overseeing proper cocoa bean processing is needed to increase cocoa bean quality which eventually will increase the income of the cocoa farmers. Two aspects of processing should be applied by farmers those are fermentation and drying of beans. Method and criteria of fermented beans and well drying should be understood and implemented by cocoa planters.

Establishment of demonstration/visitor plots is required as a means for extension to farmers in which examples of cocoa trees derived from seeds, top grafting or side grafting, with various sources of recommended grafts. In coming years, the sites can be used both for visitor plot and for multi-location testing of clones. Interest of farmers to cultivate cocoa was quite great shown by good innovation developed by them although with limited assistance. One of the innovations developed by the farmers that still needed to be further studied is the control method for CPB by fogging using the burning of egg shell. The application may reduce significantly the number of infected pods.

One of the methods of CPB control is by sanitation of infected pods which including burying the infected pods. The method of control have reduced the level of incidence of CPB to

about 10% compared to the previous condition of level of infestation of CPB has reached about 50% of the pods.

In terms of cocoa quality, the farmers have implemented fermentation of fresh cocoa beans using two wooden boxes. In the first box, the cocoa beans were fermented for 3 days followed by 2 days in the second box before being sun dried. By this method, good quality of cocoa beans will be obtained, eventually good price should be got by the farmers. Therefore, there should be leading farmers should act as extension agents in their communities.

Specialized formal information is introduced into the network by highly sought farmers, possibly reinforcing the social capital of these individuals. However, original and accessible information is also produced by on-farm experimentation. Informal advice networks are instrumental in the successful transfer of this available information throughout the farming community and provide a foundation for community-based adaptive management.

There are several implications for cocoa farming management practices, specifically within the two coal mining site communities with limited formal sources of information. The identification of highly sought farmers may play a critical role in the introduction, transfer, and implementation of new cocoa farm technologies. The promotion of community involvement may facilitate the transfer of information, not simply to introduce information, but also to promote social exchange and interaction, strengthen pre-existing informal source networks, and increase social proximity among farmers.

Highly sought farmers were more apt to be involved in community activities than were farmers who were not highly sought, promoting the likelihood of tie formation among core farmers. Both farmer-derived and formal sources of information flowed from farmer to farmer via network ties. Although farming practices may also diffuse via imitation, further research is required for a more detailed analysis of this process.

Cocoa Productivity

To increase production, effort has been made by an extensive mono-crop production of cocoa expanded in parts of mining site communities where suitable land was abundant and available. However, as the age of bearing trees increases, more intensive production techniques will be required to maintain and/or expand cocoa farm productivity. In terms of land holding, on the average, smallholder farmers working on plots ranging from 0.5 to 4 hectares. Currently, cocoa yields in the mining site communities range from 400 to 800 kg/hectare, with the potential to increase yields as 1 to 1.5 MT/ha. However, there are several the major problems faced by cocoa industry. The problem of cocoa pod borer (CPB) has been long problem for Indonesia and has affected mostly all area of cocoa plantation especially smallholders has caused significant yield loss. Though efforts has been undertaken to overcome this problem but the solution seems to be a temporary one such as applying GAP and pod sleeving method using plastic to cover young cocoa bean from CPB attack. Table 2 showed that introduction of that integrated pest management had reduced cocoa infestation by CPB in which percentage of number of pod free from CPB infestation increased while those heavily infected reduced.

Table 2. Infestation level of cocoa pod borer before and after implementation of recommendation on integrated pest management.

Infestation level of CPB	**Before**	**After**
	Implementation (%)	
Free	26	67
Light	37	26
Moderate	26	4
Heavy	11	3

Notes: Before: June 2004, After: September 2005

Since some of smallholder plantations have been planted for about 25 years, the number of aging trees is increasing. As a result, the productivity of major smallholders' plantation is low. Besides, low productivity of smallholder's plantation was caused by variety of existing tree stock, poor soil nutrition (Table 1), and bad drainage, limited availability of improved planting materials. This resulted in decreased of income potential for the cocoa smallholder farmers.

The two problems as mentioned above have contributed to low quality of bean produced by the farmers. Although efforts have been made to encourage farmers to improve quality of beans, but no price differentiate for good and bad bean has contra-productive the efforts. As a result, local processors have difficulty in procuring consistent quality cocoa which prevent them from operating at full capacity and decrease the viability of local value-addition opportunities.

Smallholder farmers lack access to acceptable collateral for financial institutions. As a result, farmers are not able to finance the purchase of inputs. With small size of land holding, many smallholder farmers are unable to sell their production in large volume and are therefore unable to benefit from direct sales with exporters and processors, which decrease their income potential.

Lack of coordination among the government, associations, private sector, and other stakeholders providing support to the cocoa sub-sector may result in inconsistent messages, non optimal applied research sharing, and limited synergies. The international market acceptability and demand for Indonesian cocoa beans of various qualities does not provide incentives for farmers to invest in improving farm productivity or bean quality.

Marketing Partnership

The main problem faced by cocoa farmers is inferior quality of cocoa beans, such as high water content, mouldy which generally caused by proper drying, beside high content of waste. By good management of cocoa bean processing in which the main role played by proper management of water inside cocoa beans will result in good quality cocoa beans. Data showed by Table 3 indicated the presence of variation among cocoa farmers in producing better quality. Farmers in Rantau Pulung produced cocoa beans with bigger size, however, nearly half of the amount of cocoa beans improperly fermented. On the other hand, those in Bengalon were much smaller although 75% of them were fully fermented.

Table 3. Cocoa bean quality based on several parameters of samples collected from four locations after interventions (2009)

Cocoa bean quality parameters	Sample locations			
	SS	RP	TP	B
Bean shell content (%)	18.0	19.9	24.8	22.8
Bean number/100 g	120	75	116	141
Beans with insects (%)	2.1	0	0	0
Mouldy beans (%)	4.3	0	1.7	0
Unfermented beans (%)	3.2	46.7	44.3	8.8
Underfermented (%)	11.7	26.7	10.4	11.8
Fully fermented (%)	73.4	26.7	39.1	75.0
Clumped beans (% beans)	5.3	0	4.3	4.4
Clumped beans (% w/w)	12.6	0	6.3	11.4

Sample Notes: SS : Sangatta Selatan, RP : Rantau Pulung, TP : Telukpandan, B : Matirowalie, Bengalon

After the cocoa farmers carry out proper processing and good quality of cocoa beans supplied, next step is the facilitation by mining companies for marketing the products. The aim is that the farmers should get suitable price for the good quality. The cocoa farmers should be acquainted with the daily price of cocoa beans in national level.

One of the main causes that the farmers, for example in Rantau Pulung, received very low price for their cocoa beans was the long market chains. For example, cocoa price received by farmers in Busang Subdistrict was about Rp.22,500.-/kg, while in Rantau Pulung the cocoa price was Rp.14,000.-/kg. In fact, distance from Busang to Samarinda is about 200 km or 8 hours drive in dry season and condition of the road was comparatively good. In Busang, cocoa beans were collected by small local traders and directly sold them to Makassar where the price of cocoa beans at the same day was Rp.27,000,-/kg. Therefore, farmers in Rantau Pulung, Sangatta and Bengalon, areas surrounding mining sites, should get the cocoa price at the level at least Rp.22,500.-/kg.

To face this problem, it is recommended to record the real volume of cocoa beans that can be supplied every month from those areas of mining site communities. Besides, it is needed to search out the existing market chain of cocoa beans in those areas and increasing the role of BPPUTK

(Bumi Pelatihan dan Percontohan Usaha Tani Konservasi, Conservational Agrobusiness Training and Demonstration Plot) to be local collector of cocoa beans from farmers under guidance of KPC and the to sell the products to exporter or to chocolate companies.

Farmer Income after Technology Implementing

Most of cocoa production is done by smallholder. This condition leads to a production system that develops slowly. The majority of cocoa farms in Berau and Kutai Regencies are small holdings owned by a large number of peasant farmers. For example, in Ghana, about 66% of farms are within the size range of 0-8 ha owned by 332,244 peasant farmers, with only 18.9% of the farms larger than 20 ha (Padi and Owusu, 2006). In Indonesia, the third biggest cocoa producers, smallholder portion contributes to ca. 80% of the national business, involving ca. 1.7 million farmer families.

Problem facing by cocoa producers frequently occurred in a long period and could only overcome by external assistance. Farmer in term of smallholder could only sustain for their food and simple live. The most problems facing by cocoa production sector consists of technical and non technical problem covering production including low productivity, pest and disease, and quality. Trade barrier, phytosanitary and sustainability issues are also the constrains for cocoa sector, especially from the developing and under-developed countries. Productivity is one of the key for success in cocoa farming. This condition is as function of technology in terms of research and development, producer's skill and socio – economic, nature in terms of climate and soil, and external issue in terms of market situation, pricing and authority policy. Productivity is one of the most important economic factors affecting the cost of production per ton of cocoa beans. At higher productivity, the cost of production per ton of cocoa will be lower and vice versa. In view of this, effort should be made to increase the productivity to as high as possible to maximize profit making.

Referring to data from Cocoa Producer's Alliance (2008), average productivity in all main production area is still low standing below 1 t/ha/year. The average national productivity in West African countries, Brazil and Indonesia, and Malaysia are 0.2-0.3, 0.5-0.6 and 0.8-1.0 t/ha/year. According to Yusof *et al.* (2000), well-managed cocoa farms produced cocoa bean at average 2.0-4.6 t/ha/year meanwhile the highest productivity recorded by Ashar and Lee (2004) is 5.0-6.8 t/ha/year. The current productivity is still remaining at a level around 30% of genetically production potential.

Cocoa Growth on Post-Coal-Mining

Demonstration plot of growing cocoa after mining activity was established in Binungan village inside the area of Berau Coal mining site. Most of cocoa trees have been planted under existing very dense shade trees. To establish a good condition for cocoa farm, some of the shade trees have to be cut down as well as the wildly grown weeds. The proportion of cocoa and shade trees should be 2:1. The field will be established as source of grafts of Sulawesi 1, Sulawesi 2, ICCRI 03, ICCRI 04 and Sca 6 clones.

The life-forms that colonize the post-coal-mining site are creeper and shrub species and unmarketable secondary tree species. The trend of succession is dependent on the site properties of post-coal-mining site. The properties of site improve with age and become more favorable for succession. This could be due to higher nutrient content and lesser heavy metal toxicity in the older post-coal-mining site (Down and Stocks, 1977). Hence, more shrub and tree species are found in the older post-coal-mining site.

Reliance on the natural succession to restore post-coal-mining site without any human aid will take a long period, during which the post-coal-mining site will remain economically barren. Hence, afforestation with suitable multipurpose tree species is more desirable than solely depending on succession for reclamation of post-coal-mining site. The benefits of afforestation on post-coal-mining site are obvious.

Preliminary results of Ang (1994) showed that several nitrogen fixing and most probably heat and water tolerant tree species adapt themselves very well on sandy slime tin tailings. A habitat oriented approach should be taken when screening species for afforestation of tin tailings. The selection of high quality indigenous timber tree species for afforestation of tin tailings will only lead to failure because of the harsh environmental conditions and poor site properties. None of the tree species with important timber values can colonise pure sandy tin tailings (Palaniappan 1974). However, several late pioneer species, viz. *Sapium baccutum* and *Alstonia scholaris* ,were observed to grow on sandy slime tin tailings, which have better site properties (Ang 1986). Another option is to utilise desert or semi-arid species, most of which are adapted to high temperatures and water stress (Ehleringer, 1980),

e.g. *Encelia* species. An alternative is to select coastal species, e.g. *Casuarina equisetifolia.*

Another approach is to modify microclimate to produce a more conducive environment for the establishment of tree species. The shrub species found in five and ten-year-old tin tailings are unsuitable for the purpose because these species grow only where moisture is relatively high, e.g. in depressions near the foot of sand dunes (Mitchell 1963), hence the introduction of heat and water stress tolerant tree species, e.g. desert or coastal species. After some years, the tin tailings properties may be improved by organic materials deposited from the plants. The tin tailings will then be more suitable for planting of other tree species. However, for sites where the water table is high, species trials showed that nitrogen fixing tree species could yield timber 30 to 40 years after planting (Ang, 1994). The constraints are that the site must be located near the water body, and it is costly to employ this irrigation system. Other methods such as top soil enrichment and mulching can be employed to improve water retention properties of post-coal-mining site.

Practical methods of improving the moisture content of sandy tin tailings are available, and hence, afforestation activities are feasible on these areas (Ang, 1994). For relatively gentle sites, the texture can be improved by the use of agriculture waste, e.g. oil palm husk available close by the sites. Dumping of post-coal-mining site must be properly planned so that each dump varies in composition (slime/sand) in order to provide a better site for reclamation after mining activities (Mitchell 1957). Manuring and mulching improve the growth of *Pinus merkusii, Paraserianlhes falcataria and Sesbania rostrata planted* on sandy tin tailings where the water table level reaches the root zone (Rodziah and Zulkifli 1990).

The rainy season is recognized to be the best time for cocoa planting (Anonymous 1963). Planting must be carried out before 10 a.m. to avoid poor establishment. Routine checking of the planting site is very important because fire is often a hazard in afforestation sites on the post-coal-mining site during the dry season; a major fire in the 1963 dry spell, for example, destroyed the establishment of *Casuarina equisetifolia* on the post-coal-mining site (Anonymous, 1963; Mitchell, 1963).

Conclusions

It is concluded that improvement of the cocoa productivity and farmer capacity surroundings the two mining sites associated with high adoption of technology by farmers, better access to availability of knowledge for good agricultural practices, extension officers, demonstration plots, cocoa price, and length of market chains, partnership, and competition with oil palm plantations.

Informal advice networks are instrumental in the successful transfer of this available information throughout the farming community and provide a foundation for community-based adaptive management.

There are several implications for cocoa farming management practices, specifically within the two coal mining site communities with limited formal sources of information. The identification of highly sought farmers may play a critical role in the introduction, transfer, and implementation of new cocoa farm technologies.

Promotion of community involvement may facilitate the transfer of information, not simply to introduce information, but also to promote social exchange and interaction, strengthen pre-existing informal source networks, and increase social proximity among farmers.

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