Level 1 consists of general classes such as: *Forest, Tree-based system, Non tree based system and Non vegetation.* These classes can be easily distinguished using visual inspections and simple vegetation index. Vegetation index is a ratio of spectral value between vegetation-sensitive channel (near infra red spectrum) and non vegetation-sensitive channel (visible spectrum) in satellite image. Result of *Level 1* is further classified in *Level 2,* In this level, spectral value is not the only parameters used, spatial characteristics such as oil palm map, field reference and *Nearest Neighborhood* algorithm was used as a rule in classification. *Nearest Neighborhood* algorithm in object-based hierarchical classification is conducted in two steps: (1) Feature space optimization and (2) Classification (Definiens, 2007). The first step is conducted to calculate combination of object features that produces the largest average minimum distance between the samples of the different classes. The combination of object features is used in the second steps to classify all objects into land cover classes in level 2. Level 2 consists of 6 land cover types such as: *Non oil palm, oil palm, shrub and grass, cropland, settlement and water. Non oil palm* class in *Level 2* are classified in more details in *Level 3.* In this level, similar parameters were applied to the smaller-size objects. Level 3 consists of 3 land cover types such as: complex rubber agroforest, simple rubber agroforest and monoculture rubber.

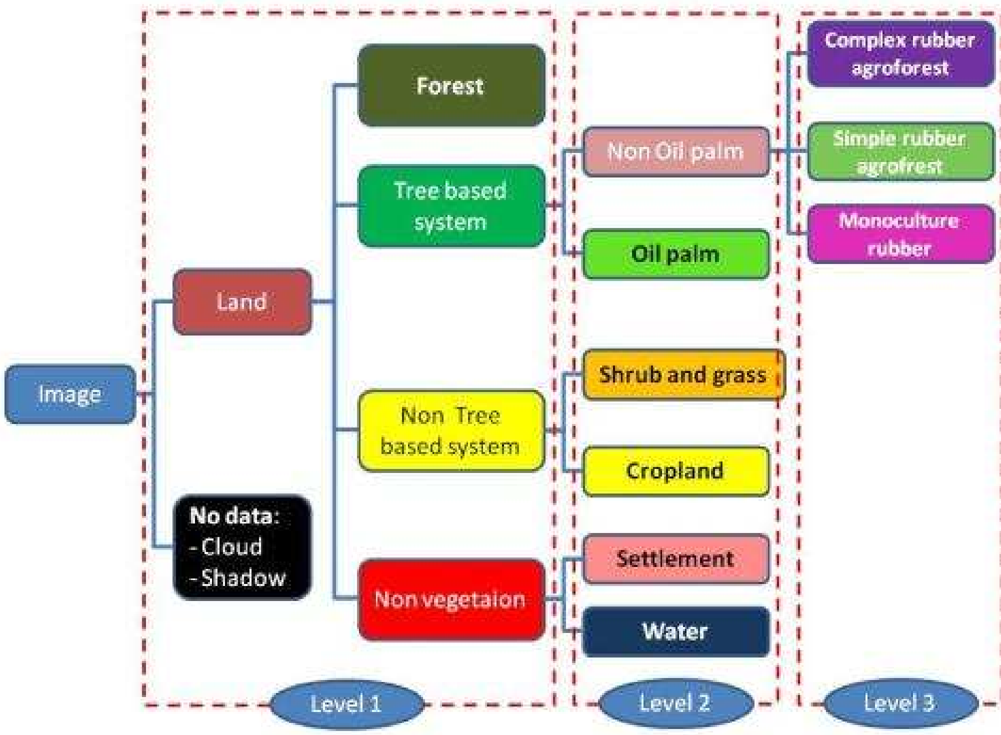

Figure 8 Hierarchical classification system

Post-classification analysis process is the last stage of ALUCT. It consists of two processes: accuracy assessment and land-cover change analysis. The objective of accuracy assessment is to test the quality of the information derived from the image classification process by comparing field reference data with the most recent land-cover map.

Two types of land-cover change analysis were conducted: area-based change analysis and trajectories analysis. An area-based change is a simple analysis conducted by comparing total area of each land-use/cover class in each time period. The result will show a clear indication of overall trend of land-cover changes in Bungo District. Trajectories analysis is conducted to quantify and summarize the sequences of changes over the period of observation.

Analysis of landscape pattern and connectivity

In the context of eco-certification, it is important to determine priority area based on identification of rubber agroforest patches that provide highest value of ecosystem service of biodiversity conservation. In this case, rubber agroforest has two services: (1) based on its vegetation structure, as secondary habitat/refugee for forest species, and (2) based on its landscape configuration as a connector of the fragmented forest patches. Priority area for eco-certification area should consider the patches of rubber agroforest that can provide these two functions.

In this stage of analysis, we observed ecological functions of rubber agroforest as a biodiversity corridor of the remaining forest patches based on calculation of landscape indices. Among a large set of landscape indices, we consider one index that are relevant to the ecological processes of rubber agroforest: *Connectivity Index*. Connectivity Index measures the functional joining between all patches of the corresponding natural habitat based on defined similarity. It can be used to capture the importance of matrix (non-habitat, non-forest cover) that can function as corridor in connecting forest patches. For this purpose, we used FRAGSTAT (McGarigal et. al., 2002) to analyse connectivity index of forest in study area.

Analysis of potential threats and vulnerability

Another aspect that should be considered in eco-certification of rubber agroforest is the sustainability of the system. One way of observing the prospects of the land use system sustainability is by observing the current government spatial planning and land designation. Using land cover data produced from ALUCT, we compared spatial distribution of rubber agroforest with current land designation and spatial planning data of Bungo District. We considered two sources of data for this purpose: forest designation map (*peta kawasan*) produced by Indonesian Ministry of Forestry and land use planning for estate plantation produced by local government of Bungo (Dinas Perkebunan Kabupaten Bungo, 2009)

RESULTS & DISCUSSION

Classification scheme and field observations result

One of the crucial phases in ALUCT is defining land cover classification scheme for satellite image interpretation. We defined our land cover classes based on field observation conducted in May 2010. We found that the landscape of Bungo is dominated by four types of land cover: (1) Forest, (2) Rubber agroforest, (3) Monoculture rubber, and (4) Oil palm. Rubber agroforest, based on its vegetation structure, is classified into two classes: complex rubber agroforest and simple rubber agroforest. Complete description for each dominant land cover types is shown in Table 8.

During field observations, we collected a number of GPS points for each land cover classes. The data collected will serve (1) as sample for image interpretation process and (2) as references for accuracy assessment. Figure 5 shows the collection GPS points.

Table 8 Description of dominant land cover types in Bungo District

No	Land use/cover types	Description
1	Natural forest	Forest is an area characterized by dense and extensive natural tree cover usually consisting of stands varying in characteristics such as species composition, diameter distribution, total basal area, which may be exploited (partly logged). It excludes tree industrial plantations. Most of forested areas in 2002 were located in the highland (>500 m asl), and only small patches were dispersed in the lowland peneplain.
2	Complex rubber agroforest	Rubber agroforest is characterized by the presence of rubber trees mixed with other tree species, which form a stand structure similar to secondary forest. Rubber trees typically account for less than 70% of the population of trees above 10 cm dbh. When the presence of non-rubber trees is dominant and the plot is old enough, the area will be very hard to differentiate from natural forest.
3	Simple rubber agroforest	Simple rubber agroforest is characterized by higher proportion of rubber trees compared than in complex rubber agroforest, which in some case accounts to more than 70%. Due its intensive cultivation system, simple rubber agroforest has a fairly homogenous canopy structure, even though the stands variation of non–rubber tree is still higher than in monoculture rubber
4	Monoculture rubber	Monoculture rubber refers to pure or almost pure stands of rubber trees. This includes intensively managed large-scale plantations as well as smallholdings, which are usually less intensively managed and may include a significant proportion of non-rubber tree species.
5	Oil palm	Oil palm plantation is characterized by a homogenous canopy structure (single dominant species) when mature, regular spatial network of roads, and clear-cut boundaries with the neighbouring vegetation.

Time series land cover maps 2002 - 2007/08

The resulting image of 2007/08 is presented in Figure 6. Cloud covered areas were fixed by inducing logical consistency for several of land cover types. For example, if an area is classified as *cloud* in 2002 and *forest* in 2005, we changed the legend of that area in 2002 into *forest.*

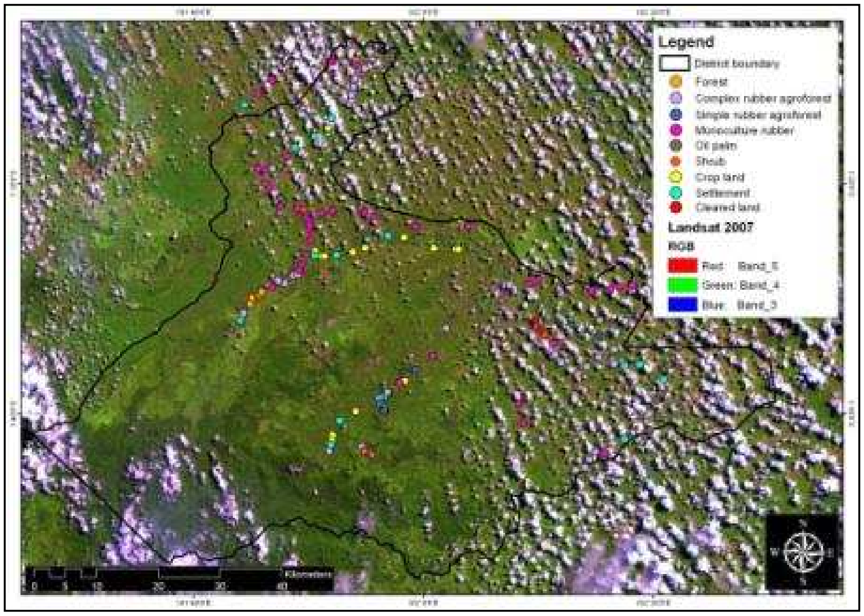

Figure 9 GPS points collected during field observations

We conducted accuracy assessment for 2007/08 land cover map using 104 GPS points. The overall accuracy is 81.3%. Some misclassification occurred between classes of complex rubber agroforest, simple rubber agroforest and monoculture rubber, which is mostly due to the similarity of canopy covers. Error matrix produced from accuracy assessment is presented in Table 9.

Table 9 Error matrix of 2007/08 land cover map

CLASSIFICATION	Complex rubber agroforest	Cropland	Forest	Mono culture rubber	Oil palm	Settlement	Shrub and grass	Simple rubber agroforest	TOTAL
Complex rubber agroforest	12	0	0	0	0	0	0	3	15
Cropland	0	2	0	0	0	1	0	0	3
Forest	0	0	5	0	0	0	0	0	5
Monoculture rubber	1	0	0	27	1	0	1	0	30
Oil palm	0	0	0	0	8	1	0	0	9
Settlement	0	0	0	0	0	20	0	0	20
Shrub and grass	0	0	0	2	1	0	3	0	6
Simple rubber agroforest	2	0	0	0	0	0	0	9	11
TOTAL	17	2	5	31	10	21	4	12	104

The time series land cover maps in Figure 7 clearly show that the landscape of Bungo district is currently dominated by monoculture tree-based plantation. In 2002, monoculture rubber had the largest areas, followed by oil palm plantation. Rapid expansion of oil palm took place in 2005 and 2007/08, where expansion of rubber monoculture seems to be slowing down. In 2007/08, most areas in the west and eastern parts of Bungo are dominated by oil palm plantations. Since most of the oil palm plantations are managed by large scale companies, the landscape configuration is dominated by a compact homogenous area, mostly located in significant distance to settlement.

Complex rubber agroforest can be seen in fairly large-continuous patches along the river in the center part of Bungo district. These are the areas of species rich-rubber agroforest system or commonly referred as *jungle rubber.* Previous study of ICRAF showed that some of these patches have existed since 1973. Patches of *simple rubber agroforest,* being a more intensively managed system, are located closer to settlement in a smaller-fragmented patches compared to complex rubber agroforest. In 2005 and 2007/08, new patches of simple rubber agroforest appeared in several locations, indicating that the system was increasingly adopted.

The land cover maps of 2002, 2005 and 2007/08 also show a decline of forest cover in the landscape. Large block of forest in the southern part of the district is mainly stable, however smaller patches in the peneplain area are clearly degraded and heavily fragmented. Land cover that replaced forest includes shrub and grass, which can be an indication of logging activity or an initial stage of conversion to tree-crop land uses.

Dynamics and trajectories of rubber agroforest

The overall Bungo district land cover change in 2002-2007/08 is presented in table 4. Four types of trends with different rates can be summarized from this data: (1) decrease of forest cover, (2) decrease of complex rubber agroforest, (3) expansion of oil palm, and (4) increase of monoculture rubber area. Forest cover in Bungo has declined from 31% in 2002 to 25% in 2007/08. Sharp decline of forest cover occurred in 2005-2007/08, where forest cover decreased from 135,697 ha in 2005 to 114,264 ha in 2007/08. On a slower rate, complex rubber agroforest also decreased from 12% in 2002 to 10% in 2007/08. Surprisingly, the area of simple rubber agroforest significantly increased from only 1,536 ha in 2002 to 2,669 ha in 2007/08. The combined areas of rubber agroforest increased in 2005-2007/08, from 10.4% to 11% as shown in Figure 8.

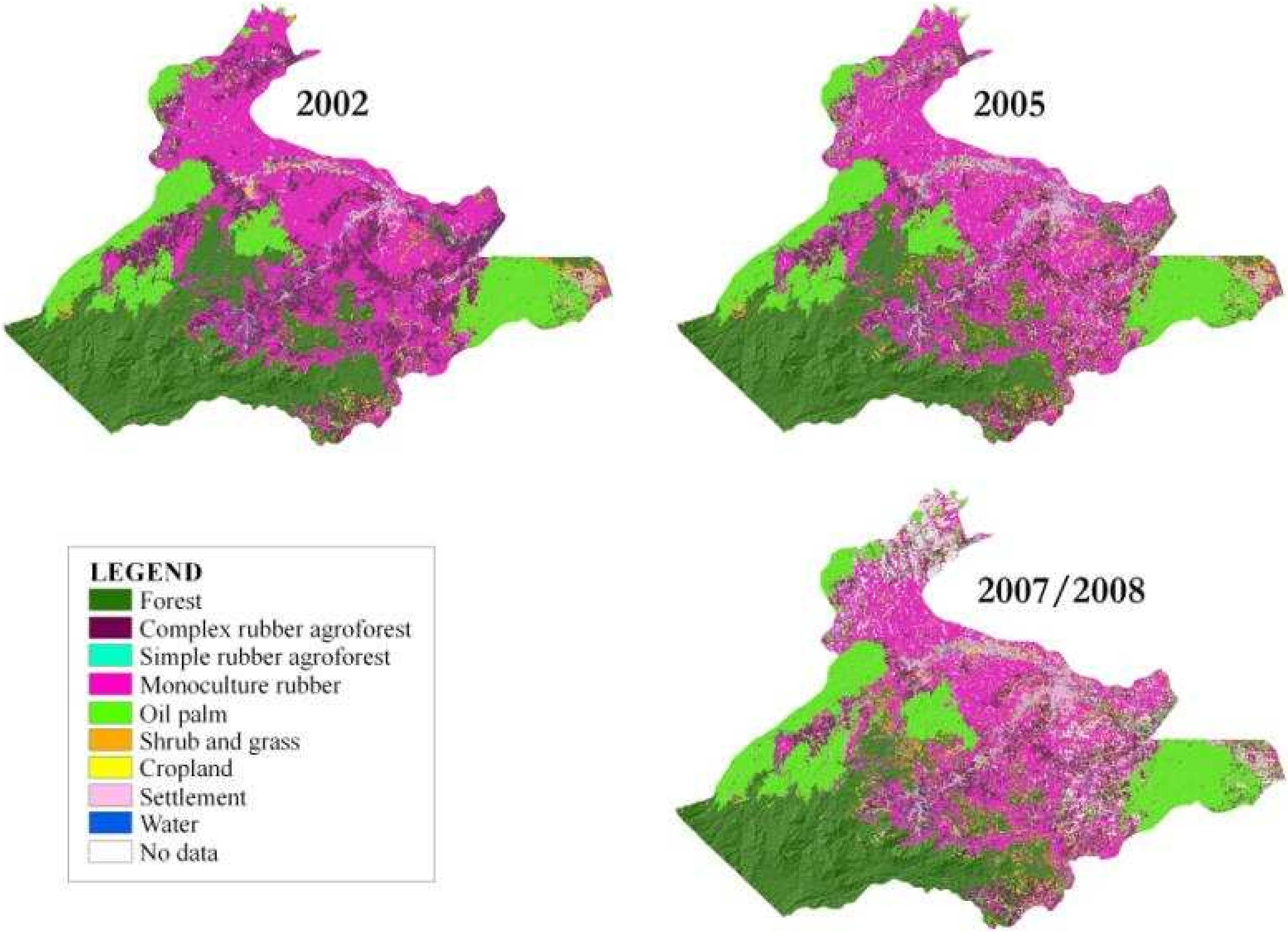

Figure 10 Land cover map 2002, 2005, and 2007/08 of Bungo District

Table 10 Summary of land cover change in Bungo District 2002-2007/08

Land cover type	2002		2005		2007/08	
	ha	%	ha	%	ha	%
Forest	139331.5	31%	135697.1	30%	114264.5	25%
Complex rubber agroforest	54710.7	12%	46358.9	10%	45062.8	10%
Simple rubber agroforest	1536.9	0.3%	1778.76	0.4%	2668.6	1%
Monoculture rubber	119936.2	26%	120880.2	27%	125352.0	28%
Oil palm	75583.4	17%	88355.9	19%	97643.4	21%
Shrub and grass	5719.8	1%	6167.8	1%	10300.2	2%
Cropland	464.1	0.1%	564.8	0.1%	563.1	0%
Settlement	34111.2	8%	46557.4	10%	47903.9	11%
Water	8273	2%	8273	2%	8273	2%
No data	14990.1	3%	23.1	0.01%	2624.9	1%
Grand Total	454657	100%	454657	100%	454657	100%

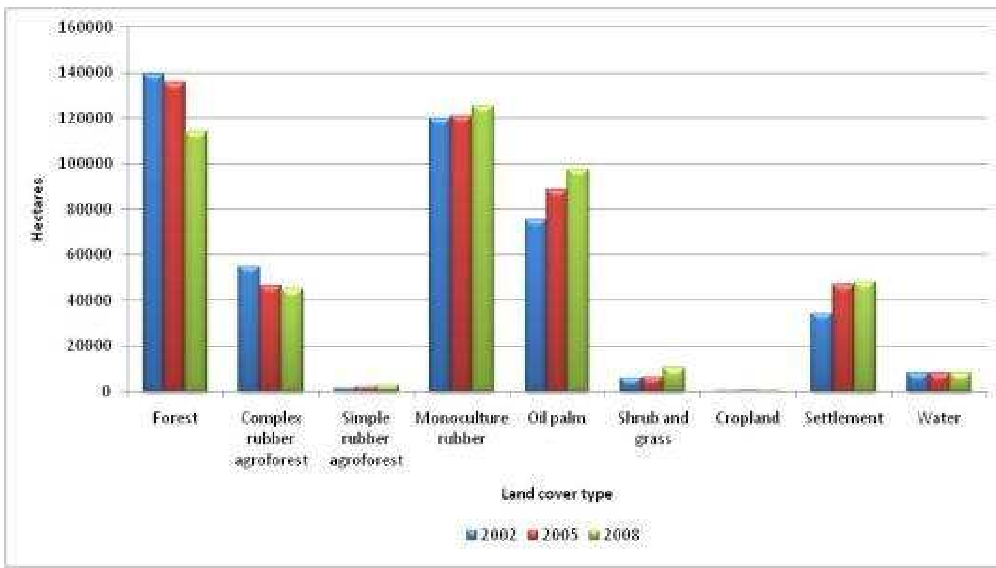

Figure 11 Land cover change in Bungo district 2002-2007/08

In-depth analysis of the trends of complex and simple rubber agroforests was conducted by looking at transition matrix of 2002-2007/08 (Table 11). Transition matrix presents a detailed overview of each transition between land cover classes within a period of analysis. Significant transition from complex rubber agroforest to monoculture plantation is clearly visible. In 2002-2007/08, 7812 ha of complex rubber agroforest was converted to monoculture rubber and 10158 ha to oil palm plantation. On the contrary, simple rubber agroforest increased in the period of 2002-2007/08, which was mostly from complex rubber agroforest (689 ha). This is an indication that farmers are adopting a more intensive agroforestry system and they started by converting/replanting their old rubber agroforest areas.

Table 11 Transition matrix 2002-2007/08

Land cover 2002 (ha)	Land cover 2007/08 (ha)							
	Forest	Complex rubber agroforest	Simple rubber agroforest	Monoculture rubber	Oil palm	Shrub and grass	Cropland	Settlement
Forest	114264.54	655.74	161.55	7605.9	4734.81	7703.82	80.64	288.36
Complex rubber agroforest		44404.47	689.76	7812.72	10158.57	1911.96	1879.92	4235.4
Simple rubber agroforest			1536.93					
Monoculture rubber		1757.07	260.73	94518.99	6957	4093.47	1472.76	12701.7
Oil palm					73799.28			
Shrub and grass		236.43	17.37	1594.08	1420.92	1294.2	85.95	1016.01
Cropland				728.55	221.76	149.76	830.34	422.46
Settlement								16178.58

Based on land cover change data and the transition matrix, we conducted the trajectories analysis of land cover changes in Bungo district, and a simple summary of dominant land cover changes within the study period was produced. In this analysis we only observed and compared the trajectories of forest and rubber agroforest since these are the two most dynamic land cover classes and are of the highest relevance to this study. Rubber agroforest is a compound class of both simple and complex agroforest classes. Summary of trajectories analysis is presented in Figure 12. It is shown that trajectories of conversion to oilpalm and rubber monoculture are similar between forest and rubber agroforest. The proportion of conversion to oilpalm is higher for rubber agroforest compared to forest area. This information suggests that even though the total rubber agroforest area in Bungo increased, possibility of conversion to oil palm and rubber agroforest also increased, which means that in the future, the areas of rubber agroforest are still under threats of oil palm and monoculture rubber expansion.

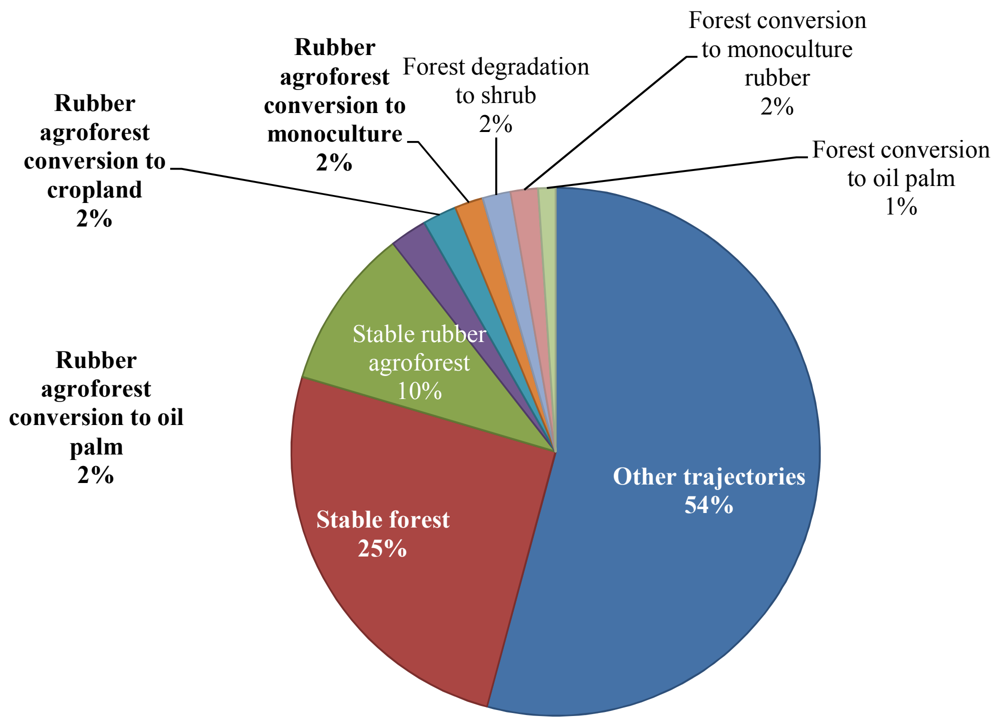

Figure 12 Trajectories of land cover types in Bungo 2002-2007/08

The role of rubber agroforest as biodiversity corridor

The trajectories analysis on rubber agroforest suggests two points: (1) simple rubber agroforest areas are relatively stable or slightly increase while (2) complex rubber agroforest is still under threat of monoculture tree-crops expansion. This implies the need of additional mechanisms that can function as incentives to prevent from the conversions to oil palm and monoculture rubber, e.g. eco-certification scheme. Further, it is therefore important to set priority areas to ensure that the implementation of eco-certification scheme is more effective. One way to determine priority is by recognizing complex rubber agroforest areas that provide highest ecosystem services for biodiversity conservation.

One type of biodiversity-related ecosystem service from rubber agroforest is the potential to serve as a biodiversity corridor for the remaining forest patches. The result of ALUCT in Bungo district clearly shows a sharp decline of natural forest from 75% of the district area in 1973 to 25% in 2007. Our satellite image interpretation of 2007also showed that the remaining forest patches are heavily fragmented. It is in this type of condition that rubber agroforest can play an important role as a connector to the remaining forest patches.

We used FRAGSTAT to spatially calculate connectivity index of the remaining forest patches based on 2007 land cover map. One important input of the connectivity index is *similarity matrix* (Table 12) which indicates the degree of similarity across land use types. For example, we assume the degree of dissimilarity of rubber agroforest (RAF) and forest is 20% while forest and non-tree based system is 80%. These parameters are assumed based on previous study on number of species in various land use type in Bungo (Dewi and Ekadinata, 2010).

Table 12 Similarity matrix of land covers type in Bungo

Land cover type	Forest	RAF	Mono-tree	Non-tree-based	Non-vegetation
Forest	1	0.8	0.6	0.2	0
RAF	0.8	1	0.8	0.3	0
Mono-tree	0.6	0.8	1	0.3	0
Non-tree-based	0.3	0.3	0.3	1	0.1
Non-vegetation	0	0	0	0.1	1

The result of connectivity index calculation presents a degree of natural habitat connectedness in percentage, where the value of 100 is perfectly connected and 0 is completely fragmented. We compared the result of connectivity index calculation with location of rubber agroforest (Figure 13). We have found that in some locations, rubber agroforest clearly shows the potential as corridor to remaining forest patches. At least three locations in Figure 10 indicate that the existence of rubber agroforest is crucial to ensure the connectedness of forest. These are the patches of rubber agroforest that are recommended to be prioritized for eco-certification process.

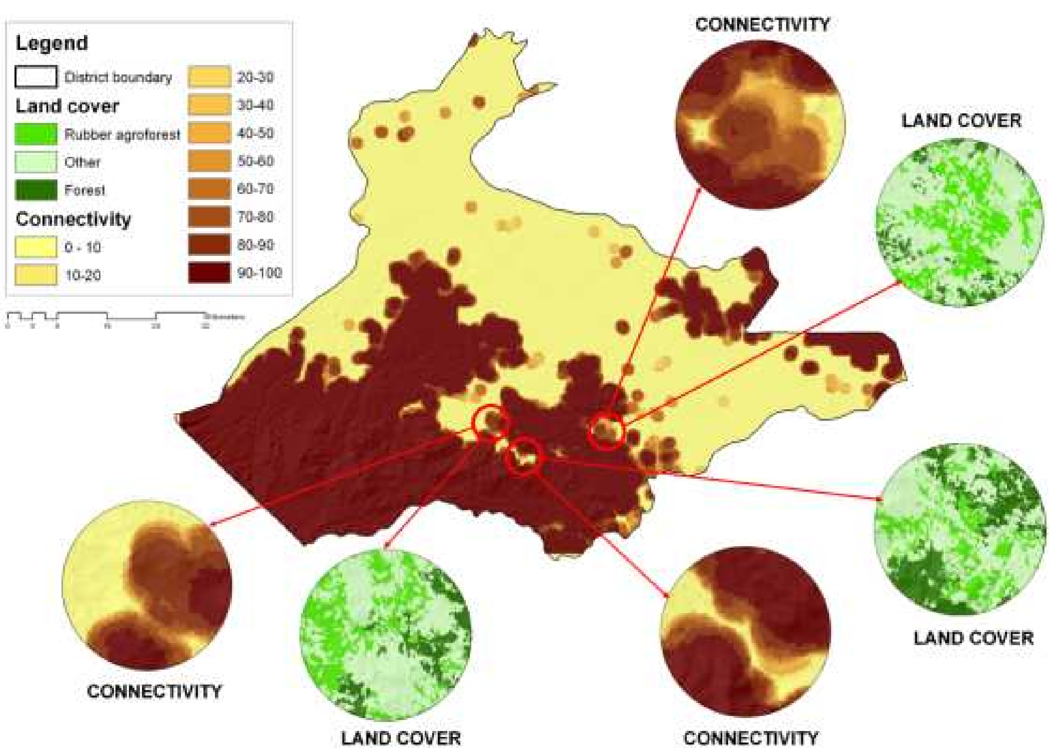

Figure 13 Connectivity index of forest patches and location of rubber agroforest

Current threats on rubber agroforest

Another way to propose priority areas for eco-certification is by observing the level of transition probability caused by existing land use designation and land use planning. We overlaid the areas of rubber agroforest in 2007/08 with 'forest designation map' (*peta penunjukan kawasan hutan)*. The result shows that 91% of rubber agroforest areas in 2007 are located in land for other use (*Area*

Penggunaan Lain/APL) which are mostly owned by local people or managed by local government (Figure 14). This has both positive and negative implications. On the positive side, this means that for most cases, future decision to convert rubber agroforest to other land use can be made by local people and/or local government. This is potentially advantageous for eco-certification scheme. However, on the negative side, the land status of APL implies competition with other-more profitable land uses such as oil palm and rubber monoculture.

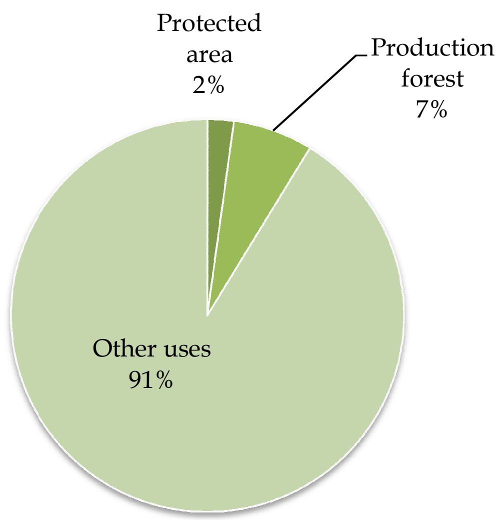

Figure 14 Proportion of rubber agroforest area in 2007 based on forest designation map

During our field work, we obtained information from local government that shows future allocation for oil palm establishment in Bungo. Some of the areas have already been under agreements with private companies, and will very likely be converted in the near future. The designated area is covered mostly by of complex rubber agroforest. Figure 14 shows an overlay of land allocation maps with current location of complex rubber agroforest. In total, 47062.89 ha (47%) of complex rubber agroforest area falls under the allocated lands for oil palm. These areas are currently the most vulnerable patches of rubber agroforest in Bungo district. Since some of the patches provide important function as biodiversity corridor, the eco-certification might be the right a scheme to support the conservation purposes.

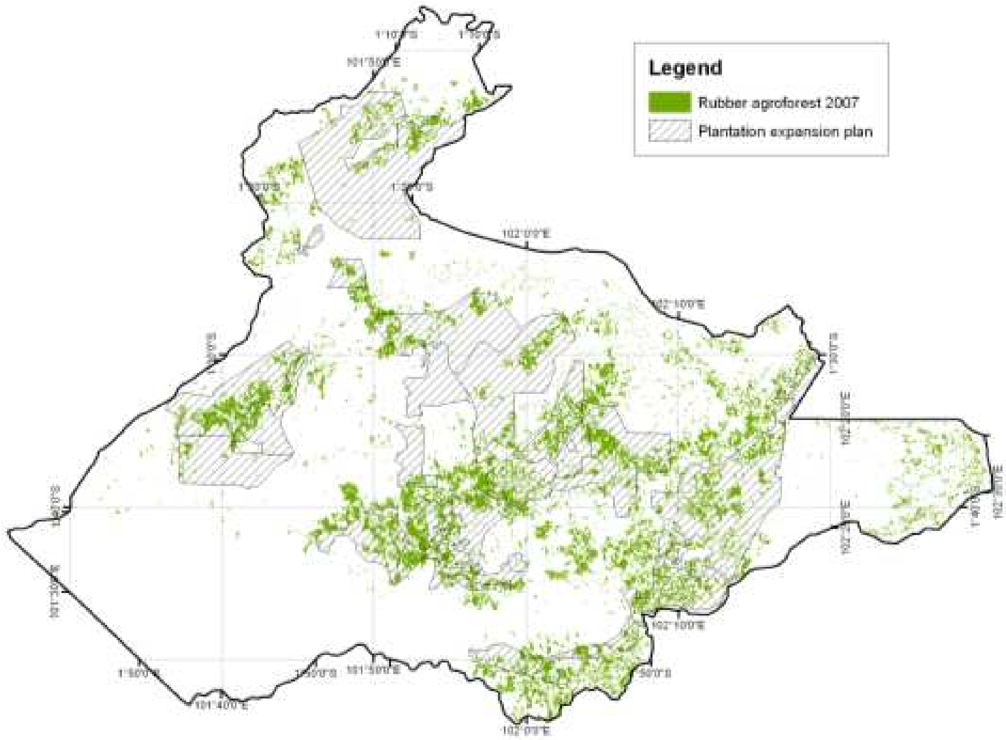

Figure 15 Land allocation for plantation expansion and location of rubber agroforest

CONCLUSION

Our analysis shows that rubber agroforest areas in Bungo District, Jambi, are currently undergoing high pressure from the expansion of monoculture plantation. The species rich-complex rubber agroforest system is currently decreasing, some of which is converted to oil palm in 2005-2007/08. Simple rubber agroforest shows quite significant increase in terms of transition rate, even though from the landscape perspectives the total area is not significant compared to complex rubber agroforest. Current spatial planning of Bungo district also puts some pressure to rubber agroforest area, where 47% of complex rubber agroforest is currently allocated for oil palm plantation expansion.

APPENDIX 3 MULTI-STAKEHOLDER PERCEPTION AND PREMIUM PRICE ON RUBBER ECO-CERTIFICATION IN BUNGO DISTRICT, JAMBI

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INTRODUCTION

Land utilization through forest conversion is no longer seen as the correct option for Bungo District. Land use planning based on District Spatial Planning (*Rencana Tata Ruang Wilayah Kabupaten* – RTRWK), which focuses on sustainable land utilization should be taken into consideration. Thus, landscape cover in Bungo District could become a possible corridor for existing conservation areas.

From a spatial perspective, the remaining forest cover in Bungo District is very low, and it is located in areas which are not supposed to be converted to another non-forest land use. Currently, the forest cover in Bungo District is no greater than for monoculture plantation and is tending to continue to decrease. On the other hand, since 1999, plantation area has exceeded the amount of forest cover and is tending to continue to increase (Ekadinata and Vincent, 2008). The high rate of deforestation has made the conservation aspect of agroforestry even more important and therefore it can make a real contribution to species conservation.

One of the schemes offered is maintaining rubber agroforest, which has been practiced by the community over a long time and from generation to generation. The result of rubber agroforest is a prime commodity in Bungo District which can increase community welfare and provide regional income. In order to stay competitive in the local, national and international markets, a market chance for a rubber commodity is needed. Eco-certification is one of the ways to make the rubber price competitive in the international market. It is a big challenge to implement this scheme, since precise approaches are needed in order to facilitate understanding by various stakeholders.

Rubber Production

There are two categories of rubber products. The first is natural rubber resulting from tapping rubber trees and this has several technical advantages compared to synthetic rubber. The second category is synthetic rubber, a derivative from petroleum or other minerals. The biggest derivative product from rubber is tyres (73%). Percentage of world products derived from rubber is delivered in Figure 16.

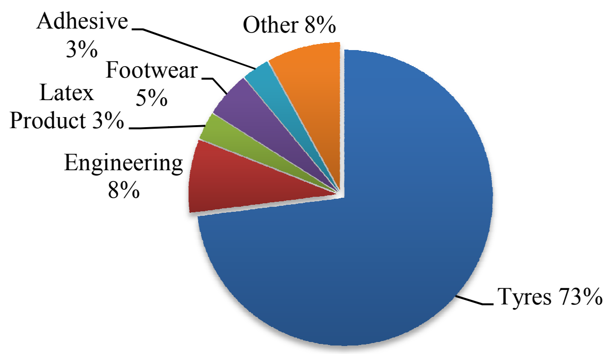

Figure 16 Percentage of world products derived from rubber (Bakrie Sumatera Plantations, 2009)

Indonesia is the second biggest natural rubber producer in the world. Almost 85% of the rubber produced comes from community rubber plantations. Around 73% of world rubber production and 90% of Indonesian production is utilised by tyre factories. Many small farmers have limited knowledge about many aspects, including nursery management, clone certification, market access to rubber, rodtip cloning, high quality planting material, good tapping practice and the methods to increase coagulum quality. Most of this lack is due to minimal technical assistance and training.

Rubber latex is one of the prime commodities of plantations in Bungo District. Average production reaches 725 kg/ha with total production of 32,496 ton/year from 91,470 ha (BPS, 2007). Rubber is a commodity which has the greatest plantation area compared to other plantation commodities, while oil palm has the highest productivity (543,834 ton) compared to other commodities. Rubber community plantations in Bungo District have low productivity (600 kg/ha/year) despite the fact that it is a prime commodity (Akiefnawati *et al.*, 2008). In Lubuk Beringin village, most occupants are involved in rubber farming. On average, production reaches 10-20 kg/ha/day (2.4 ton/year), assuming farmers work a five-day week.

To date, the community is still maintaining the agroforestry system, since it has additional value compared to monoculture systems. In addition to being an hereditary tradition, the agroforestry system protects natural balances and maintains biodiversity. The different fruits and timber it produces diversify the community's income.

Other research results on tree species and vegetation structure analysis of rubber agroforestry systems in Sumatra's lowland (de Foresta and Michon, 1994) and several other studies show that biodiversity in rubber agroforests is higher compared to intensive cropping and monoculture plantations. As reported by Michon and de Foresta (1995), vegetation diversity in a rubber agroforest could protect around 50% more species compared to 0.5% in a monoculture plantation. This supports the implementation of a certification scheme for agroforestry production.

PERCEPTION ON ECO-CERTIFICATION

Farmer Level

The term eco-certification is not yet a familiar one among rubber farmers. Farmers only know that rubber is tapped and sold to collectors and then delivered to the factory. However, they were very enthusiastic after the eco-certification scheme had been explained to them. They did not realize that most of their rubber plantations were young rubber plantations (simple agroforest) and old rubber plantations (complex agroforest). Indirectly, their production comes from the land that still is maintained by local wisdom.

Basically, the farmers agree with having an eco-certification scheme. Moreover, their rubber products could penetrate the international market. This is their ticket to be able to compete with other products. The main aspect is to be able to compete on price with the *toke* or other collectors in the local market. The farmers think that if the result of certified rubber production is a lower price in the local market, then the scheme will be hard to implement. They are used to selling latex to collectors with a relatively competitive price and low transportation cost.

If the scheme is run well, the farmers will be willing to commit and participate in the long term in rubber eco-certification. The commitment will be built, if there is trust between the certification institution, the buyer and the farmer. The establishment of a Co-operative (*Koperasi*) institution to facilitate this scheme will help the farmers, since it will facilitate their need for capital.

Other than that, there is a proposal to build a temporary factory or shelter close to their gardens. This could reduce the transportation cost and thus, the farmers' profits will be higher. The distance from their garden to the main road on average is about 1-3 km, so they need appropriate means of transportation. Alternatively, at the very least, the existing infrastructure should be developed, so that the transport of rubber latex is smooth and economical.

Local Government Level

The perception of eco-certification among local government agencies (Forestry and Plantation Agency, Regional Planning and Development Agency, Agriculture Agency) is positive. Moreover, this is related to the increase in the quality and price of rubber from the agroforestry system. The increase in the rubber price may increase rubber productivity, which is one of the prime commodities of Bungo District. With eco-certification, the production of agroforest rubber has higher value than that from monoculture production, which tends to have lower ecological value. Rubber certification is one of the ways to maintain an agroforestry system that covers half of the Bungo District area.

Forestry development needs to take into consideration several principles that enable forest function and benefits to be achieved sustainably, by calculating the production capability and present and future interest. The forest is expected to provide timber for which the demand is increasing, along with the annual increase in population growth. However, the capability of the forest to provide wood cannot keep up with population growth. Therefore, it is hoped that the community will be willing to take part in providing material for timber by planting trees for wood production on their land.

Forests, in addition to providing timber products, are also expected to be able to increase the welfare of the community inside and outside the forest area. The low economic level of the community in the vicinity of forest areas is believed to be the reason for forest destruction. However, if forest is capable of giving a benefit to the surrounding community, then the community will support efforts to conserve it. Therefore, the community's welfare becomes the focus of all efforts to conserve forest.

The plantation sector provides a significant contribution to the economy of Bungo District. Through its primary commodities (rubber and oil palm), the plantation sector in Bungo District is expected to be able to increase the community's welfare. Although in 2007, the area of rubber plantations increased by 3.16%. Most of the existing plantations is old rubber plantations, totalling around 22,902 ha and therefore have low productivity.

Consequently, the Forestry and Plantations Agency of Bungo District will continue its efforts to increase and optimize the production and productivity of community rubber plantations by providing superior seedlings, eco-certification, enhancing production facilities and fertilizer needed by the community, through activities financed by the District or Province or from the National Revenue and Expenditure Budget.

In addition, the Forestry and Plantations Agency of Bungo District is trying to change the thinking pattern of the community, who always think of extending the size of their garden rather than increasing its quality. A high quality garden with superior seedlings, fertilizer and recommended medication treatment is far more productive and saves more energy. Increasing the productivity becomes the priority, not expansion.

The Forestry and Plantations Agency of Bungo District will also continue to build production roads in community plantation areas, so that the community can transport production facilities to build their gardens and to market the products from their gardens more easily.

In building a high quality garden, the assistance of field extension officers is needed. As the spearhead of the Forestry and Plantations Agency of Bungo District, extension staff should have the information and knowledge needed by the farmers. The information and knowledge could be obtained from reference books, mass and electronic media and from education and training provided by the Training Office or conducted by the Agency.

To achieve its vision and mission, the Forestry and Plantations Agency of Bungo District requires supporting facilities and infrastructure, which can support their work in the field. To conserve the forest, technical facilities and infrastructure, such as measuring tools and fire extinguishers, are needed, with the latter being critical to extinguish and prevent the spread of and consequent increased damage from forest fires.

Human resources should also be taken into consideration. Technical work in the field requires staffs who understand their jobs. Therefore, additional technical personnel are needed who can work in accord with the main tasks and functions. In addition to technical personnel, additional administrative staffs are needed, so that an orderly-administrated working environment can support work in the field.

In the relation to eco-certification, local government has an important role as a policy maker. On this particular issue, local government has established a policy on "Village Forest" to maintain the condition of Bungo forest through agroforestry utilization. Implementation of eco-certification with policy support will result in real contributions. Certified rubber will open local, national and international markets, and thus, will increase community welfare and regional income. Apart from the village forest policy, there is not yet any other regulation or policy established by the local government; everything else refers to Law Number 41 on Forestry, Law Number 5 Year 1990 and the Plantations Law.

Based on existing perceptions, many challenges might occur. The increasing population in Bungo will cause an increase in the demand for land. This will trigger new land encroachment in the existing production forest area. The challenge ahead is how to make the community maintain the existing agroforestry system. With an eco-certification scheme, rubber production from agroforestry can compete in the international market.

Non-Government Organization (Facilitator) Level

Non-Government Organizations (NGOs) have a very important role in eco-certification. NGOs facilitate the implementation of this scheme by assisting the farmers. It requires time and a precise approach to build the right perception among the farmers, although they already have the hereditary local wisdom to mix plants in a plantation system with other plants, which is appropriate for certification.

Increasing the rubber quality, while maintaining the favourable conservation conditions of rubber plantations is required using an agroforestry system. Besides obtaining maximum quality, there are also other values that can protect the natural balance. An agroforest should conserve biodiversity and provide other positive results, such as penetrating international markets, competing with big companies and becoming a permanent source of income for farmers.

With rubber eco-certification, the steps in the process of rubber production from upstream to downstream could be identified. This would provide an initiative for management from farmer gardens to the factory (market). This certified product would be in harmony with the agroforestry system and sustainable production.

In Bungo District, the important role of facilitation is being carried out by KKI-WARSI. Promotion is required of the initiative to push rubber plantation management using an agroforestry system to increase the rewards for the farmers. Not only the management, but also the management plan, capital, facilitation, commitment, knowledge exchange, networking and mediation with various stakeholders are required.

Market and Certification Institution Opportunity

To date, there is not any market for eco-certified rubber, which can be contrasted with timber products, where there are more market opportunities for eco-labelled wood. This market segment can play an important role for the farmers in the end production chain. In reality, rubber agroforest farmers have the reputation of "high dirt". This has had a negative impact on the market and the buyers. There is a difficulty to build up the image of the agroforest product compared to that from monoculture plantations that have low biodiversity.

The need for natural rubber in tyre production is projected to increase. Figure 17 shows the level of car ownership in several countries in the world. In addition, the increase in the crude oil price will affect the synthetic rubber price. This should be a driver for consumers to use natural rubber. Thus, the natural rubber price has a strong correlation with the oil price. Nowadays, the natural rubber price is at its highest level for the last 30 years, being USD 3,240/ton (June 2008) and USD 2,372/ton (October 2009).

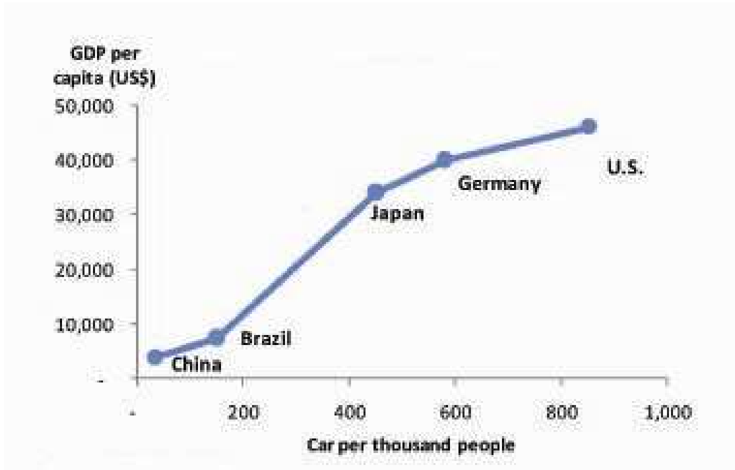

Figure 17 Car ownership level in several countries

Certification implementation refers to a system with standards, a procedure, minimum requirements and guidelines. The certification system must contain comprehensive criteria and indicators as guidelines for forest management unit performance evaluation (Gunawan and Bayunanda, 2010). These components make up the procedure for the implementation of a certain certification system. Moreover, there should be minimum requirements for certification executors and a responsible academic method for certification decision making.

In Indonesia, Lembaga Ekolabel Indonesia (LEI) – the Indonesian Ecolabel Institution is a non-profit organization that is responsible for accreditation and is the certification system developer and prepares infrastructure needed for certification. A certificate of community-based forest management is a leap in the recognition process and assists publicity of the management unit. Publicity derived from certification can even attract other national or international institutions to study other related aspects. In short, eco-certification can reach a broad audience at the national or international level.

CONSTRAINTS AND CHALLENGES

Rubber agroforest eco-certification is a complex scheme. Rubber agroforests produce low quality latex compared to monocultures. It should also be realized that the farmer uses very simple (minimum) technology and depends on a broker to sell the rubber. Thus the farmer is not aware of the rubber price for different qualities, such as the dry rubber level. The factory does not make the price public, because of confidentiality reasons.

In general, there are two constraints to rubber certification. The first is an internal constraint and the second is an external constraint.

1. Internal constraint
   The internal constraint is related directly to the characteristics and management of the farmers, such as:

a. Farmers have low awareness of rubber certification

Rubber certification is a new concept for rubber farmer in Bungo District. Their knowledge is limited to tapping and selling to the broker, they do not know what is needed or how to implement a certification scheme. Farmers need to improve their understanding to increase the quality of the product.

Farmers do not have a business orientation to managing their fields. Most of them are traditional farmers with a small area, limited knowledge and a lack of technological adaptation. The weakness of agricultural producers, especially farmers is that they are unaware of the quality of their product, and thus, its agribusiness product value, which currently is not at its best export level.

b. Cost and capital for rubber certification

Financial aspects are a common major problem in the national or international certification process. The eco-certification process requires capital to increase rubber farmer management performance. Rationally, rubber business actors (including farmers) will think twice if they believe that the certification process will reduce their financial performance. Field research shows that most Indonesian business actors are still reluctant to adopt the system, because they see no incentive in doing so.

Eco-certification costs will vary, but are greater for a small-sized area. It has been claimed that a certification program is not economically feasible for adoption by small-scale and family- based forest areas that are less than 1.0 ha (Lindstrom *et al*., 1999; Rickenbach, 2002). This is a major challenge considering that most farmers manage land less than 1 ha.

In the Indonesian context, agroforestry can contribute partially or wholly to covering the cost of certification of a community forest. While it is true that it is difficult for a community to afford the certification costs, it seems such costs are more affordable for a government institution. Through government support, it seems that problems related to a certification fund could be solved, so that community forest certification can be implemented in the field.

c. Rubber farmer management and institutions

Institutional and rubber agroforest management aspects could be huge obstacles in eco-certification. There is great variation in the way that agroforest farmers manage their land. Technically there is little difference in the way to manage a rubber agroforest and a monoculture, but the production results can be significantly different.

In addition, a structured administrative work plan is not available, yet this aspect is one of assessment points that most certification institutions use. Possible steps to be taken would be to empower the rubber farmer group, for instance, by establishing a credit union that could give soft loans to farmers. This, however, would need intensive facilitation from the government, NGOs and academics to enable a solid institution to materialise.

2. External constraint
   a. Market for rubber certification

   The market where a product is sold is the end of the custody chain. Rubber consumers play an important role in rubber eco-certification promotion. Their willingness to pay a premium price for an eco-certified product will attract farmers to adopt an eco-certification scheme. Most buyers will purchase a product if it does not cost more than a similar uncertified product (Ruddell and Stevens, 1998; Tiesl *et al*., 2002; Jensen *et al*., 2003; Anderson and Hansen, 2004). The consumer still acts as a profit maximiser, preferring a good quality product at a less expensive price.

   b. Programs offered by certification institution

   Interest to commit to a certification scheme depends very much on the certification program developed by the certification institution. If the standard places a greater burden on farmers, they will most likely withdraw their participation. Farmers will choose a more flexible standard, because they realize even if they apply sustainable management practices, there might be shortcomings in land management, especially in the production aspect. Farmers that show an interest in certification surely need facilitation to choose a certification program that will benefit them. This is important, because each farmer has limited information on the advantages and disadvantages of each program. The decision to choose a program is influenced not only by the standards being developed by existing certification institutions, but also by the need to adopt a program that is acknowledged by the market, especially the international market. A combination of these two factors - the certification standard and market recognition - will influence forest farmers in choosing a certification institution that is suitable for them.

   c. Government regulation related to rubber certification

   Government policy plays a major influence in certification implementation. The certification scheme must be in line with existing regulations. The Indonesian National Standard (SNI) implementation regarding product quality can be viewed from two sides.

   The first viewpoint is the standard related to the appearance of the product. The implementation is voluntary and not legally binding. Generally it is an agreement between the buyer and seller. The second is the technical regulation. In relation to rubber eco-certification, Bungo District policy will have an impact on the on-ground implementation. At present, local government has already established a permit system for plantation or oil palm companies. This is in conflict with an eco-certification scheme, because in contrast, the government do not have a policy of enabling agroforestry.

   In the meantime, there are no factories that are yet willing to receive eco-certified rubber near the plantation areas. There are four rubber factories that service farmers in the Bungo District and surrounding areas. Therefore, if Bungo District wants to implement eco-certification, there should be at least one factory willing to accept rubber from the farmers. If the rubber is sold to other places, such as outside Jambi province, there is a high transportation cost, with the assumption that the factory will pay a higher price.

The establishment of Ministry of Trade regulation Number: 10/M-Dag/Per/4/2008 on the Indonesian Technical Specification for Natural Rubber (SIR) to be exported brings fresh air into the discussion on the implementation of an eco-certification scheme. To maintain quality and competition, keeping the image of the Indonesian product and business certainty for the natural rubber producer (SIR), the existing regulation needs to be improved. The existing SNI is a standard established by the National Standardization Body and is applied nationally. Technically Specified Rubber (TSR) Indonesia or Standard Indonesian Rubber (SIR) is natural rubber from a mechanical latex treatment and rubber material derived from *Hevea brasiliensis* tree, with or without chemical compounds and meets the SNI quality requirement.

APPENDIX 4 ENHANCING RUBBER PRODUCTION IN COMMUNITIES AROUND A VILLAGE FOREST IN BUNGO DISTRICT, JAMBI PROVINCE

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SUMMARY

Rubber is the main commodity for the people of Jambi. The livelihood of 98% of the community around *Ndendang hulu Buat* Village Forest in Bathin III Ulu Sub-district, Bungo District depends on tapping rubber trees. The rubber farmers work from dusk to dawn on their plantations located about 1 km toward the hills, and they return home late in the afternoon. Rivers provide one mode of transportation for the rubber harvest. On average, the quality of dry rubber content is 40-50%. The low harvest and dry rubber content (DRC) of the community plantation is caused by an incorrect tapping method. Farmers do not use the right coagulating agent/acetic acid to coagulate the rubber, they cast a rubber mould in an earthen mould, and immerse the rubber harvested in water.

Keywords: low rubber productivity, correct tapping methods, ways to enhance rubber harvest quality from protected rubber plantation.

BACKGROUND

Rubber is the primary commodity in Bungo District, Jambi. The community rubber plantation in Bungo District covers 91,470 ha and produces 32,496 tons (Bappeda and BPS, 2007). The low productivity is due to the old age of 98% of the plantation (aged plantation covers 5,392.71 ha, with an average annual productivity of 725 kg/ha/year), and the selection of inferior seedlings (planting germinant).

Rubber is always identified with a strong odour but smells good when farmers receive money from selling it. The current price of rubber is very high. Village farmers can receive IDR 9,000-13,000/kg depending on the quality. Rubber quality is determined based on the dry rubber content (DRC). Normally the DRC from community farms ranges from 40 to 60%. This is due to the treatment during and after harvest of creating thick slabs, immersing the rubber in stagnant water or in the river (Figure 18), as well as the addition of tapping bark or battery acid, TSP fertilizer and other compounds into the rubber harvested. The farmers think that the selling price for their products is related to the weight of the rubber instead of its quality, so they try many ways to add to its weight.

Rubber quality is greatly affected by treatment during and after harvest. In general, the rubber farmers of Bathin III Ulu Sub-district (Bungo District) do not understand the term DRC. The distant location of the rubber plantations from the villages and the difficulty of transportation also decrease the product's DRC. The river is one of the primary ways to transport rubber products from the plantations to the village. The distance and hilly topography make these farmers rely on the river as the chosen mode of transportation. The farmers come from the lower economic class, and when the rubber is transported to the village they sell their product immediately to local collectors (known as *toke*), which only provides them with a low selling price due to the condition of the unprocessed wet rubber product. The already low selling price receives a *basi* cut or is reduced by 10% from the total rubber weight to compensate for water shrinkage.

In addition, the low DRC is caused by the use of improper coagulants by the farmers. They usually add a thin vinegar solution, as well as battery acid or TSP fertilizer and other coagulants (such as floor cleaners).

To increase the rubber productivity of the village forest community, ICRAF together with KKI-WARSI conducted a study to enhance the community's rubber harvest to obtain a better rubber selling price through training sessions covering tapping and collecting rubber lump.

Box 2 Development of Rubber Commodity Jambi Province

I. Development of Rubber Production and Export

A rubber price increase on the international market causes an increase in rubber exports and volume in Jambi Province. In 2005, the rubber export volume increased by 9.99%, (127.4 thousand ton), in 2004 to 140.2 thousand ton and in 2005 income increased 10% from USD 142.99 million to USD 157.28 million. Growth is expected to keep rising, because the world demand for natural rubber is increasing; in 2015 it will reach 10.6 million ton and in 2035 it will be 15.03 million ton. Indonesia and Vietnam are countries with the most potential to supply the world rubber market demand by increasing their productivity or by increasing the area under rubber through expansion, if possible.

Rubber export table in Jambi to 2005

	2003	2004	2005	Growth	
				2004	2005
Export (USD)	92,319,348.78	142,987,229.12	157,285,952.26	54.88	10.00
Volume (kg)	105,144,406	127,432,918	140,176,209	21.19	9.99

(Data derived from Kompas 7 March 2006)

Most of the rubber export from Jambi province (65% to 70%) goes through ports in Jambi province, Talang Banjar, Muara Sabah and Tanjung Jabung Barat; 25% goes through Teluk Bayur port in West Sumatra; 5% to 10% goes through Palembang.

The low added value of rubber is caused by the low quality of the rubber and the fact that it is exported in the form of *bokar* (basic material of rubber) which is crude rubber. *Bokar* production is 250,000 ton/year, but of that amount, only 125,000 ton meets SIR.

Jambi Province plantation exports by the SITC group

SITC	March-2006	Apr-2006	2006	Segment		Growth
	53,885,274	160,015,472	160,015,472	Apr-06	March-06	
	in USD					
Coffee, tea, cocoa, spices	49,189	142,421	163,911	0.13	0.06	189.54
Crude materials, inedible	29,727,952	44,688,477	104,187,238	41.47	35.05	50.32
Crude rubber	28,727,938	43,019,651	99,118,847	39.92	33.87	49.75
Fixed vegetable oils and fats	6,918,760	2,196,250	31,855,414	2.04	8.16	(68.26)
Total plantation	65,423,839	90,046,799	235,325,410	83.55	77.14	37.64
Total export	84,811,018	107,770,548	427801492			27.07

The rubber area in Jambi province in 2005 was 565,000 ha, with an average production of 725 kg dry rubber/ha/year. This was low compared to Vietnam (1,100 kg/ha/year) and Thailand (1,500 kg/ha/year). The low productivity is affected by high rubber management costs which cost USD 0.65/kg, due to most rubber plantation belonging to communities and generally being old rubber. The old rubber area is 120,000 ha or 21.24% of all rubber plantation in Jambi. The old trees have low productivity (250 kg dry rubber/ha/year).

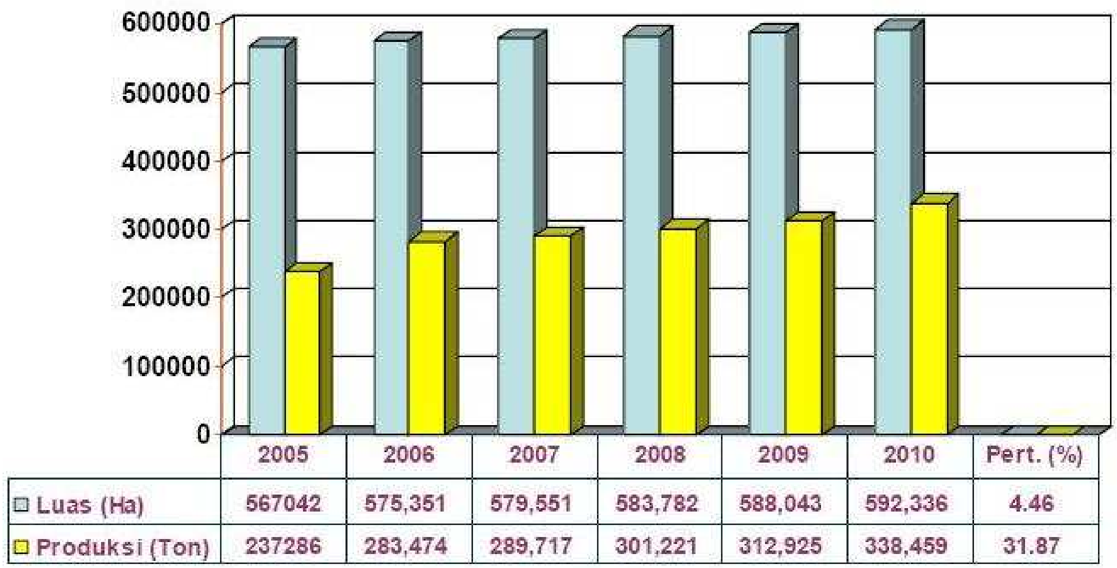
II. Rubber Development Program

The Jambi Provincial Government has allocated 10% of their budget to replant old rubber with the main target being community rubber plantations or a total budget of around 60 billion rupiahs for rubber regeneration of 17,500 ha in 2006. Up to 2010, local government has allocated a budget to replant 130,000 ha of rubber in Jambi Province.

Rubber Development Plan in Jambi Province

ACTIVITY	Development Plan (ha/year)				
	2006	2007	2008	2009	2010
Rubber regeneration	4,170	4,200	4,231	4,261	4,293
Fertilizer	17,500	25,000	27,500	27,500	33,156
Area extension	468,911	472,334	475,782	479,255	482,754

Rubber Area and Production Target



For industrial development, the target in 2007 is to establish two rubber factories that will process crumb rubber in Sarolangun District. These factories will expand rubber production in Jambi City in cooperation with the investor:

- PT Golden Energi Jambi with a capacity of 15,000 ton/year, located in Muaro Ketalo village, Mandiangin Subdisctrict (being built since July 2005).
- PT Angkasa Raya Djambi with a capacity of 36,000 ton/year located in Dusung Lesung Batu, Rantau Tenang village, Pelawan Sikut Subdistrict (build in early February 2006).

These factories will help farmers or rubber land owners to sell their rubber and they will also absorb local manpower.

Figure 18 Rubber collected that is very thick (left) and immersion of rubber harvest to add to its weight (right).

Aims

1. To enhance the quality of rubber harvest by communities around the Bathin III Ulu Sub-district.
2. Train farmers in the correct methods of tapping and rubber harvest treatment.
3. Improve the community's rubber market by selling their products directly to rubber manufacturing factories.

Outputs

1. Rubber farmers are able to produce a clean harvest. Although the rubber harvest is transported by river, they have to dry their products for two weeks before selling them.
2. Farmers will obtain a good selling price by selling directly to the factories, rather than selling to collectors.

METHODS

The study was conducted in the Bathin III Ulu Sub-district in Lubuk Beringin, Laman Panjang, (Kampung Sungai Mengkuang Kecil and Sungai Mengkuang Besar), and in Buat villages (Kampung Sangi and Letung).

To increase the farmers' knowledge of rubber cultivation and ways to improve rubber production, the farmers were given training on the correct methods of rubber tapping, collection and the use of acetic acid. The training was carried out collaboratively with PT. Bridgestone Sumatra Rubber Estate (PT. BSRE), and was held in the Laman Panjang sub-village office during March 2010. Twenty seven rubber farmers and traders took part in this training.

To study the interest of the farmers and traders in a change in the quality of the rubber harvest and trade chain, an individual survey was also conducted

Farmer Background

Results of interviews with 136 respondents in four villages in Bathin III Ulu Subdistrict showed that the main source of income was rubber. Most farmers had only elementary school education, while some had attended until junior high school, high school or to the bachelor degree level (bachelor in religious study).

The smallest rubber garden was 1 ha and the largest more than 10 ha, with farmers of larger holdings usually employing someone to tap the rubber. Rubber stands averaged between 250 to 1,000 rubber trees and only a few people had more than 6,000 trees. Their rubber gardens were generally mixed rubber gardens, indicating that they also had other trees, including *petai*, *duku*, *durian*, *cempedak* and *bedaro*.

All rubber gardens were old (between 20 and 81 years) and seedlings came from local rubber species. The rubber garden pattern was a simple rubber agroforest consisting of rubber, fruit trees and wood trees such as *jelutung*.

Community Rubber Production Quality

Productive rubber stands consist of 250-200,000 trees. Farmer taps rubber for 4-5 days consecutively without a break. Tappings from day 1 to day 3 are collected in a bowl and tapping from the last day (day 5) is collected as latex. The rubber lump then will be put in a sink and later combined with latex that has already been mixed with vinegar (as a coagulant).

Community rubber production is between 20 and 5,000 kg per week, with average daily production being 12 kg/ha (KKK 40-50%). Only production from Senamat Ulu village had a better rubber quality (KKK>60%) compared to the other villages. The quality was low because the latex was soaked in water and farmers did not clean the latex, so it was mixed with bark and even batteries filling. The purpose of such actions was to increase the weight of the latex (Figure 19). Most rubber farmers received information on the properties of good quality rubber from the merchant, factory and training conducted by ICRAF. Their assumption was good quality rubber was clean from dirt (in local language known as ‘tatal’). It was hard to get dry rubber, because the farmers were always immersing their latex in water.

Figure 19 Thick slab rubber mixed with *tatal* (left) and rubber material mixing (bokar) with battery filling (black area in the right picture).

RUBBER MARKETING LINK

Rubber farmers sell their produce to a local trader in their own villages (Figure 20). They usually have very close brotherhoods. When latex production decreases because the rubber leaves are deciduous and the farmers are unable to earn enough, they will get a loan from their traders ('toke'). This relationship not only occurs in rubber trading, but continues beyond rubber trading activity and is used for daily and household needs (such as school tuition fees, marriage, etc.) where they can borrow from toke and then pay the money back gradually after they sell their rubber. Over long periods, farmers make many loans and by so doing, they lose their bargaining position with the trader.

The local traders sell the rubber to midlevel toke (from other district or other villages), who then sell directly to the rubber industry. In cases where rubber production cannot cover the farmer's household needs, they will mortgage their rubber garden to toke, and may end up merely as tapping labour on their own land.

Another trade system involves selling the rubber directly by rubber auction, which operates biweekly. The positive aspects of this arrangement are: (1) many rubber buyers attending may offer better prices without any 'basi' cut (weight differences deducted because the rubber has shrunk due to water loss); (2) farmers are not trapped in debt dependence to toke; and (3) farmers receive better prices than under toke. However, the downside of this arrangement means that the farmers need about 2-3 days to queue and wait for the auction and payment and there is no close brotherhood relationship between the seller and the buyer.

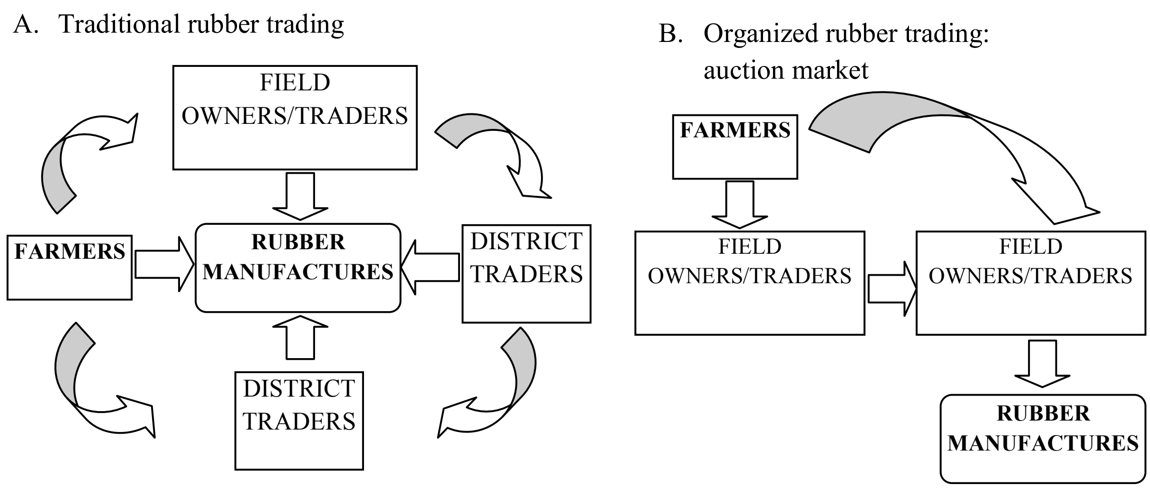


Figure 20 Scheme of organized and traditional unorganized rubber trading.

Community Rubber Production

Community rubber production averages 5-10 kg/day/ha. This low rubber production is due to: (1) the age of the rubber stands (older than 30 year); (2) the productive stands have a low stocking (around 200 trees/ha); and (3) the rubber seedlings are not from a prime species. Even with the low production rate, community rubber gardens in the Bathin III Ulu Subdisctrict have high biodiversity, because there are many timber species and fruit trees.

In general, communities in the Bathin III Ulu Subdistrict formed their latex into thick slabs and immersed them in water. However, some of the farmers who had participated in the training did not use the immersion method and instead kept the rubber under their stage house. The survey responses indicated the following production results from the four villages:

Table 13 Rubber production at four villages in Bungo District

Village	Rubber production (ton/month)
Lubuk Beringin	12-20
Laman Panjang	24
Buat	8-20
Senamat Ulu	40

APPENDIX 5 AN ARTICLE ON MOU SIGNING BETWEEN ICRAF AND BRIDGESTONE JAPAN

SEA; the Tales

World Agroforestry Centre (ICRAF) Southeast Asia

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New Staff
Condolence
Wedding Bell

Pulau Tidore

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MOU Signed with Bridgestone Japan

By Robert F Finlayson

The Centre signed a memorandum of understanding with Bridgestone Japan on Thursday, 29 April 2010. Bridgestone, the world's largest tyre manufacturer, will provide ¥2,000,000 (USD 21,000) to fund a cost-benefit analysis on improved quality of jungle rubber, train local farmers in how to get better rubber from their trees and share the results of the research worldwide.

The activities will build on the Centre's previous and existing research and training with jungle rubber communities, particularly in Jambi Province in Sumatra.

Acting Regional Coordinator ICRAF SEA, Retno Utaira signed the agreement with Mr Hideki Yokoyama, Vice President, Central Research, Bridgestone Japan.

1

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