THE DEVELOPMENT OF LOCAL ECOLOGICAL CRITERIA FOR SUSTAINABLE OIL PALM PLANTATION IN BELITUNG ISLAND (A CASE STUDY IN NYURUK AND TANJUNG RUSA)

Annisa Joviani Astari[1], Chay Asdak[2], Oekan S. Abdoellah[2], and Jon C. Lovett[3]

[1] University of Twente, Enschede, The Netherlands
[2] Universitas Padjadjaran, Bandung, Indonesia
[3] University of Leeds, Leeds, United Kingdom

ABSTRACT

The Development of palm oil in Indonesia has been associated with its environmental impact. Concerns such as deforestation, biodiversity, and greenhouse gas emission which will lead to climate change had triggered the stakeholders' urgency in initiating the sustainable palm oil certification scheme, namely RSPO (Roundtable on Sustainable Palm Oil). This certification scheme included numerous criteria that have to be fulfilled by the palm oil companies. However, the scheme is not incorporating the local ecological concerns as part of the assessment criteria, whereas, if they are applied, will contribute to better monitoring process towards the sustainability. In order to cover this issue, it is necessary to characterize the criteria based on each plantation site's characteristics. Using the ecosystem approach principle, this case study emphasizes the prioritization of the ecological criteria. The case study was conducted in Nyuruk and Tanjung Rusa, Belitung. The High Conservation Value (HCV) criteria have been used as guidance in formulizing the proposed ecological criteria based on ecological condition of Belitung. Afterwards, the perception of palm oil stakeholders gathered to mediate the prioritization of the criteria. As results, the conservation of water resources and forest; the wildlife conservation and firing prevention; and endangered ecosystem conservation, key habitat, and ecological corridor for the species were considered as having high priority. Moreover, both the landscape and topography considerations; and the flood prevention in the plantation area were considered as having low priority. To conclude, we recommend incorporating the reviewed local ecological criteria in the existing sustainable palm oil certification scheme.

Keywords: *Ecosystem approach, local ecological criteria, oil palm, sustainability*

INTRODUCTION

The concept of sustainability raises many different practical question, ranging from how the consumption of natural resources must be balanced with its renewing pace and how to uses the natural resources as efficient as it is needed to be reserved for the future generations (Mayer, 2008). The operationalization of the sustainability concept is needed to facilitate the effective implementation. This is where the Criteria and Indicator (C&I) enter and functioned as an information tools for sustainability concept (Sheil, Nasi, & Johnson, 2004).

The implementation and operationalization of sustainability concepts also has to consider three pillars, which is the economy, social and environment. However, in many cases, socioeconomic criteria are given greater weight than ecological considerations (Hammond, Adriannse, Rodenburg, Bryang, & Woodward, 1995; Roberts et al., 2003). Thus, the ecological criteria especially related to the local system are the important element for the realization of sustainability concepts.

The local ecological system is the important element to be considered as the input-output economic activities will influence the local environment as well as affecting the whole ecosystem. Moreover, the climate changes which occur nowadays (e.g. variation in temperatures, the amount, timing or form of precipitation; or change in ocean currents) will greatly influence the lives of animals, plants and microorganisms as a component of ecosystem. Therefore, the strategy for integrated management of local ecological system which include land, water, and living resources will promote conservation and sustainable use in an equitable way (CBD, 2014). The consideration of ecological aspects in the end will provide many economic advantages such as produce better quality products which will enhance global competitiveness.

Takin case study in Indonesian palm oil sector, this research IS aiming to determine the local ecological criteria which will support the implementation of sustainability concept.

Palm Oil Plantation in Indonesia

Indonesian palm oil sector, in the last 10 years, faces allegations of its unsustainable production. The forests conversion into oil palm plantations is causing concern for the ecological implication and monoculture planting which can lead to the fragmentation of high conservation value of the forests. The conversions of forest to palm oil plantation also threating the local communities since their needs were fulfilled by the forestry products (Ardiansyah, 2006). Threats to biodiversity values are also one of the ecological impacts that emerged with the increasing of oil palm ex ansion (Lewandowski and Faaij, 2006). One of the examples IS the reduced number of Orang- utans that are only found in tropical forests of Borneo and Sumatra. It was predicted that the Orang-utan extinction would happen in the future due to the expansion of oil palm plantations (Nellemann *et al*, 2007).

Due to the impact of palm oil plantation and the sustainability of the future oil palm plantation, many concerns and attempts arised. For instance, palm oil expansion which often created by draining and burning pearland is sent huge amounts of carbon emissions into the atmosphere thus potentially results on global warming and climate change. These sustainability issues have triggered increasing dissatisfaction of consumers over oil palm production practices in Indonesia and elsewhere, and have urged several non-state organizations such as World Wide Fund for Nature (WWF) and Rainforest Alliance to initiate palm oil certification programs (Grundmann, 2010). Moreover, the certification scheme for sustainable palm oil also started to established. In 2004, the RSPO (Roundtable on Sustainable Palm Oil) as a non-state palm oil certification system was initiated (Schouten & Glasbergen, 2011). The RSPO was formed by WWF in late 1990s when they included palm oil in their activities. WWF explored possibilities of private sector partnerships for setting standards for sustainable palm oil. RSPO comprised some principles and criteria (P&Cs) for sustainable palm oil. In 2008, the National Interpretation of generic P&Cs for Indonesia has been approved.

The national interpretation of P&Cs in Indonesia, however, do not specifically include the ecological characteristics of each island, whereas, every island is unique. The difficulty of implementing the national criteria therefore triggering us to study the characteristics of ecology in one of Indonesia's island, and determining the ecological criteria that suitable and also based on stakeholders and local people input. The local case study can give overview about the condition and threats in the local area as well as identifying which aspects that need to become priority for the realization of sustainable of oil palm plantation. A set of ecological criteria can create the synergy between the oi1 palm plantation and its surrounding ecosystem, as it is has been aimed in the sustainability concept.

THEORETICAL FRAMEWORK

Ecosystem Approach and Management for Determining the Ecological Criteria

Based on the scope of ecology, level of organization in nature and space (spectrum ecologists), ecosystem level is the level most appropriate to view analysis related to environmental problems (Yafee, 1999). The economic activities often resulting an impact on the ecological systems. The ecological strategy and ecosystem approach tries to keep ecosystem intact by protecting its natural abilities like ecological stability and ecological resilience. The ecological criteria and indicators, then derived from ecological strategy which are measured in physical units (Rennings & Wiggering, 1997). In addition, the ecological criteria also measured in the high conservation values and service of ecosystem.

The concept of ecosystem approach basically rooted in ecology. However, the term is broader, and can be applied in several disciplines such as anthropology, human ecology, planning, management, political science, organization science, and psychology. Most generally, an ecosystem approach is a methodology for studying a "system" that models it, its environment, and the interactions between them (Slocombe & Regions, 1993). This ecosystem approach could provide the holistic ecosystem management which important for sustaining resources in the complex ecological or political landscape (Clark & Minta in press in Grumbine, 1994).

An important element in this ecosystem approach concept is the understanding that humans are part of the ecosystem. Instead of monitoring of the main components of other ecosystems such as the existence of natural populations of flora and fauna, the availability of natural habitats, the sustainability of ecological processes is also an element in this approach (Grumbine, 1994). Ecosystem approach can translate of how big source of raw materials of palm oil can make a positive contribution to the ecosystem and also the surrounding environment in addition to the negative impact that currently continues to be criticized. The ecosystem management itself defined as a blend of scientific knowledge about ecological relationships within the framework of economic and social thought of detailed values and lead to the common goal of protecting the integrity of natural ecosystems in the long term (Grumbine, 1994). The management of clear objectives in the management of ecosystems is important in determining its success. Grumbine (1994) define five specific objectives in maintaining ecological integrity, namely:

1. Maintain the natural populations that may be living in situ,
2. Represent various types of natural ecosystems within the protected area.
3. Maintain ecological and evolutionary processes exist (eg hydrological processes, nutrient cycles, etc.).
4. Managing in a long period to maintain the sustainability of species and ecosystems.
5. Accommodate the utilization of resources and ownership for people in certain limits

Stanley Jr. (1995) revealed that ecosystem management is one approach to the sustainability of integrity, biodiversity, and also the productivity of ecological systems. Ecosystem approach in managing natural resources will support the ecological integrity to accommodate human needs in a sustainable manner (Yafee, 1999).

Ecosystem approach therefore is very suitable to be applied in determining the ecological criteria for a specific area. The ecosystem approach encompassed the problems which might encounter, and also focused on various elements of biotic interactions. Further, to obtain a more general management scale, and to determine the ecological criteria on a national scale, the regional based management can be applied. This approach manages the regional scales and focused on landscape ecosystem units. The principle is that the ecosystem as a spatial unit that is integrated in accordance with the hierarchy of geographical units (Yafee, 1999). This ecosystem approach can be applied for mapping the set of ecological criteria which will support the sustainability of oil palm plantation. The combined of holistic ecosystem approach and the results of field analysis that provides information on ecological characteristics will integrate the conceptual approach and the empirical data from the field.

METHODS

This case study is specifically conducted to determine the ecological criteria of oil palm plantations area which convert from the tropical rainforest in Indonesia. When the land converted from non-forest area (for example the ex-mining area) the ecological criteria might be different. To operationalize this research, the combinations of qualitative and quantitative method were used.

The qualitative part has been utilized to determine the criteria based of the ecological characteristics in Belitung Island. The collection of data at this step carried out with the study of the HCV identification document in Belitung. The data are including data on nature conservation areas established by governments or by local agreement (protected areas); data of the presence of endangered species (based on IUCN Red List, CITES, government regulations and local agreements); data on field identification of local natural areas for endangered species, a key habitat areas where there is a collection of species; data on distribution of the natural landscape in the plantation areas; and data on distribution maps of locations that have a rare or endangered natural ecosystem; and data on climate, topography; and physiography of Belitung Island. For validity, the data has been checked by HCV expertise and local people. The criteria and indicators then composed based on the ecological data. Literature on criteria from existing certification system such as RSPO, Cramer Criteria, and RSB also reviewed.

The second step of this research is the prioritization of final ecological criteria by stakeholders based on proposed set criteria on the first step. The purposive sampling method is used to determine the most important stakeholders in the palm oil sector in Belitung Island and ecological expert. 20 stakeholders were selected to judge the criteria. Those stakeholders including four people from the palm oil company in Tanjung Rusa region, four people from the company in the Nyuruk, four people from the Belitung province government, four people from the government of East Belitung and four people from the group of ecological expert. Additional information also gained from village chiefs and the local people of Tanjung Rusa and Nyuruk.

The assessment process carried out by face to face interview with stakeholders. The stakeholders were asked to give rate and value of the set of criteria that has been determined based on the ecological characteristic of Belitung Island. Some indicator of the assessment has been informed to the stakeholders before the assessment process. In the end, the respondents were also asked for opinions about the practicality of the set of proposed criteria and the possibility to include other criteria that not yet determined in accordance with the conditions of local ecosystems of Belitung and East Belitung districts.

The technique for criteria assessment that used is a Multi Criteria Analysis technique recommended by CIFOR (Mendoza *et al.,* 1999). Multi-criteria analysis (MCA) is a decision making tool developed for multi-criteria complex problems that include qualitative and or quantitative aspects of decision-making process. Multi-criteria in multi-criteria analysis that used in this study is the multiple criteria that require input from stakeholders' preferences as an element in the decision making process. Stakeholders with their each role will have different interests, and assessments made by stakeholders will be considered based on various factors, including social and economic factors. This input will provide the priority of criteria to facilitate its implementation.

RESULTS AND DISCUSSION

The Ecological Characteristics of Belitung Island and the Proposed Ecological Criteria

Geologically, the island of Belitung has been separated from mainland Sumatra since thousands of years ago (Whitten- et al.2000, Voris, 2000 in Yustian, 2007). The size of Belitung Island is 480,010 ha, and included into the category of small island according to Indonesia Minister of Maritime Affairs and Fisheries Decree number 41 year 2000. The forest Area was 177.421 hectares, consisting of 87.868 hectares of production forests, 86.962 hectares of protected forest and 2591 hectares of conversion forest (Profile of Agriculture & Forestry Development Department of Agriculture & Forestry Bangka Belitung Province, 2008). The area that used in this research were two areas of oil palm plantations managed by private companies. The first area was Nyuruk, in East Belitung with an area of 3500 hectare that already have permit (581 hectares area has been planted), and Tanjung Rusa region in Belitung with an area of 2512 hectares location permit (1282 hectares area has been planted) in March 2010. This area is located nearby the residential area and the farming population as well as side by side with the Protection Forests and Production Forests.

The conservation areas in Belitung Island, only found in the Belitung District, based on the data distribution of conservation areas in the Pacific Islands (Indonesian Ministry of Forestry, 2005.). For Nyiiruk in East Belitung, although there is no conservation area, based on forest land use agreement map, it was known that the oil palm plantation in this study is located between the protected forests and production forests. The area of forest production in East Belitung was 40,709 ha. While in Belitung province wide area is 46,255 ha of production forest and 44,961 hectares is protected forest area, as well as other uses of the area covering 135,562 hectares (Bangka Belitung Agriculture and Forestry Department, 2010). This Protected forests has a function as a physical protection and water conservation, and flora and fauna protection including rare and endemic species. Since there is no conservation area in this region, this forest has a role as the main habitat for flora and fauna in this area.

Belitung Island also has the largest Kerangas Forest *(Forest Heath)* in Sumatra (MacKinnon, 2000). Heath forest areas classified by IUCN *(The International Union for the Conservation of Nature - World Conservation* Unions with the status of *vulnerable* (Loucks, 2001). Heath forests are generally dominated by acid soils are flooded with a pH below 4 and has a clay content slightly. Kerangas Forests were very sensitive from fire, therefore the increase temperature and its impact to this area has to be considered. Many studies have documented responses of ecosystems, plants, and animals to the climate changes that have already occurred (Parmesan 2006; Rosenzweig et a1. 2007). These studies demonstrate many direct and indirect effects of climate change on ecosystems. Extreme temperatures, both hot and cold, can be important causes of mortality, and small changes in extremes can sometimes determine whether a plant or animal survives and reproduces in a given location (Commitee on Ecological Impacts of Climate Change National Research Council, 2008).

Bangka Belitung has a variety of plant species and endangered species. There are 34 species of plants and animals protected in the entire province of Bangka Belitung. Some species have been identified have important value and threatened by extinction, thus attract international attention. In addition, there are some endemic and protected by the laws of Indonesia. The important species that have been identified consists of 11 species of mammals, 21 species of birds and 6 species of reptiles. Those species of which are as follows (Indonesian Government Regulation No. 7 of 1999 dated January 27, 1999, concerning Types of Plants and Wildlife).There are two important mammals in the study that identified by endangered status of IUCN, protected by CITES, and also protected by the Indonesian Law. Those important mammals are Tarsier *[Tarsius bancanus saltator)* and *Trenggiling (Manis javanica).* In addition, some other animals also face threats of extinction are deer *[Muntiacus muntjak)* and *Jelarang (Ratufa bicolor).* Based on observation in the field, the surrounding palm oil plantation was simultaneously grown with other plant such as *Mucuna sp.* which is used as a *Cover Crop Legumes (LCC).* The LCC is useful to increase the nutrients in the soil, and also reduces the soil surface from erosion and suppress weed growth (Sutarta and Harahap, 2004). The plantation areas in Tanjung Rusa are dominated by plants Gelam as cattails, and some areas are areas affected by tidal marsh. Protected forests in this region is Gelam marsh vegetation, grassland and forest, while there are also partially covered by protected forest vegetation of mangrove HoiesV *(mangroves).* In the research site, there has been found an important trajectory path which categorized as temporary habitat for the animal. For instance, there is a narrow marsh along the river covered by plants *daffodils.* Based on identification and the information from the local community, in this location it was reported the existence of crocodiles and snakes python. Preservation of this area is very important for ecological corridor of the species. Ecological corridor is a green lane for wildlife activity that connects one region with another region that maintains the availability of adequate food.

The existence of palm oil plantation, and climate change also caused the decrease of endangered animals. The palm oil plantation in this island was 58,692 hectares in Belitung District and 33,414 hectares in the East Belitung District (Ministry of Agriculture Directorate General of Plantation, 2010). When their habitat is in vulnerable condition including replace by other habitat or the difference in temperature, many species have responded by extending their range boundaries. However, plants and animals needing to move but prevented from doing so, then are at greater risk of extinction. Shifting species ranges, changes in the timing of biological events, and a greater risk of extinction all affect the ability of ecosystems to provide the critical services (products, regulation of the environment, enhanced human quality of life and natural infrastructure) they have been providing (Commitee on Ecological Impacts of Climate Change National Research Council, 2008).

Based on ecological characteristics of oil palm plantation in Belitung Islands, the specific ecological criteria and its indicator have been formed. The criteria and indicators are presented in Table 1.

Prioritization of Ecological Criteria

The second step of this research consists of determination of value and ranked of the proposed ecological criteria in Belitung Island by stakeholders. From the assessment that made by the respondents (stakeholders) and the Multi-Criteria Analysis, the results of the combined weights is as follows:

Table 1.The Set of Proposed Ecological Criteria Based on the Characteristics of Belitung Island

No.	Criteria	Indicators
1	The conservation of the important area identified by the status of the area, the authenticity of communities, ecosystems and the existence of endemic flora and fauna, rare and endangered species.	Indicator 1.1. A clear delineation of the boundaries of conservation areas with the plantation. Indicator 1.2. The existence of a buffer area which is the boundary between protected areas and the plantations. Indicator 1.3. The conservation of mangrove forest vegetation and Gelam swamp forest in the area that affected by the tidal marsh.
2	Protection of flora and fauna endemic and restricted range and rare species, endangered or endangered according to national legislation and international (IUCN and CITES) and has a specific function according to the local community.	Indicator 2.1. The existence of *the Standard Operational Procedure* (SOP) and the identification and inventory of flora and fauna endemic and restricted range and rare species, are threatened with extinction. Indicator 2.2. The Monitoring of the dynamics population of endemic flora and fauna, especially rare and endangered species such Tarsier *(Tarsius bancanus saltator)*, Trenggiling *(Manis javanica)*, Jelarang *(Ratufa bicolor)* and Sambar *(Rusa unicolor)* as an important mammalian species; important bird species such *Elanus caeruleus, Haliaeetus leucogaster, Circusspilonopus, Spizaetus cirrhatus;* and important reptile species such *Siebenrockiella crassicollis and Cuora amboinensis.* Indicator 2.3. Installation of signs as a form of protection of biological diversity, and the announcement to employees and the community. Indicator 2.4. Seeding and planting of local or native vegetation species. Indicator 2.5. Periodically monitoring reports.
3	Preservation of rare ecosystems that function as a provider of environmental services for the other subsystems.	Indicator 3.1. Preservation of heath forest ecosystems as one of the endangered ecosystems. Indicator 3.2. Preservation of flora which is an indicator of a rare vegetation ecosystems, such as *Semar sac* or *Nepenthes sp.* as an indicator of heath forest vegetation.
4	Preservation of temporarily key habitat for some individual and population.	Indicator 4.1. Preservation of the area that became the path that connects the activities of animals of one area with other areas (ecological corridors).
5	Conserving the natural landscape area within the plantation.	Indicator 5.1. Deliniation of forest area in low hills within the plantation.
6	The planting has to be conformed to the landscape ecology and topography.	Indicator 6.1. On a less steep slope, it can still be developed for planting, while for steep slope, it should be maintained as forest for environmental conservation.
7	The existence of conservation areas as a source of water for daily life such as springs, water bodies such as swamps, lakes and rivers to meet the needs of clean water and latrines for communities and providers of ecosystem services.	Indicator 7.1. The protection of rivers flowing in the plantation areas. Indicator 7.2. The existence of dense vegetation in upstream areas. Indicator 7.3. The existence of conservation areas were flooded, flood plains, swamps and peat as an area that will hamper the rate of water flow and water storage areas. Indicator 7.4. Within a radius of 200 meters from the spring should be free of cultivated plants, especially oil palm. Indicator 7.5. There was an effort to maintain regional lowly and potentially vast pool of water contained in the plantation areas.
8	There is an effort to prevent flooding in the surrounding plantation areas	Indicator 8.1. Utilization of timber after the *land clearing*, thus not to impede the flow stream. Indicator 8.2. No river streamlining to prevent the acceleration of the river flow.
9	Do not do the planting or restrict if the area is prone to erosion.	Indicator 9.1. The provision of border rivers as areas of erosion and sedimentation control.
10	Conservation for the area that serves as a bulkhead to land and forest.	Indicator10.1. The existence of water bodies such as rivers and swamps and the border river (trench as plantation area boundaries can also be included in this category).

Table 2. The result of calculating the combined weight of all stakeholder groups

Criteria (C)	Combined Weight					
	Palm Oil plantation employees		Government		Ecologi-cal Expert	Mean
	Tanju-ng Rusa	Nyuruk	Belit-ung	East Beli-tung		
C1	17.2	10.6	14.8	14.4	11.5	13.7
C2	11.6	9.4	10.9	9.5	10.6	10.4
C3	5.3	10.7	10.5	9.3	10.7	9.3
C4	9.3	7.1	7.9	7.3	12.1	8.8
C5	6.3	7.7	10.5	6.8	8.0	7.9
C6	8.1	9.1	8.3	8.7	7.5	8.3
C7	15.6	13.2	13.7	17.0	14.7	14.8
C8	6.2	11.1	6.6	8.6	7.5	8.0
C9	8.0	10.6	7.7	7.8	8.6	8.5
C10	12.4	10.4	9.0	10.5	8.8	10.2

Based on the combined weight results, the criteria on the conservation of water resources for daily life such as springs, water bodies such as swamps, lakes and rivers for subsistence clean water as well as providers of ecosystem services and will be useful for local community in the surrounding areas (criteria 7) has been weighted and ranked very high by most of stakeholders. Afterwards, criteria I about conservation for critical area that marked by the status of the area, the authenticity of communities, the existence of rare, endangered and endemic flora and fauna or ecosystems, became an important priority after criteria 7. The high weight for this criterion especially given by the Tanjung Rusa's employees group and by the group of governments from Belitung Province. Other interesting result can be seen in the combined weighting of criteria 5 (Conserving the natural landscape area within the plantation), 6 (the planting has to be conformed to the landscape ecology and topography), and 8 (there is an efforts to prevent flooding

in the surrounding plantation area), where all groups of respondents gave the lowest scores compared to other criteria.

DISCUSSION

Criteria on Conservation of Water Resources

Based on the combined weight results, the criteria on the conservation of water resources for daily life such as springs, water bodies such as swamps, lakes and rivers for subsistence clean water as well as providers of ecosystem services and will be useful for local community in the surrounding areas (criteria 7) has been weighted and ranked very high by most of stakeholders.

Due to use of water for irrigation, or increasing evapotranspiration after harvesting period, the usage for oil palm plantation could increase. The water increase water usage could disrupt water supplies in areas that already experiencing water scarcity (Lewandowski and Faaij, 2006). The fears of water shortage in the future related to oil palm plantation make all parties, whether governments, local communities, environmental practitioners and also the company has a great attention to this aspect.

Based on the ecological characteristics of Belitung, this island is lack of ground water sources (the only one source of ground water is Mount *Tajam,* which is the highest mountain in Belitung). Thus, the ground water resources is very essential and need special attention when the oil palm were planted in this island. Many water source comes from the surface water that flow through the temporary spring in the surface called *head water* in local language. Meanwhile, when the dry season comes with a very low rainfall, the water discharge becomes very limited. Local communities and plantation workers stated that when the dry season, this area experiencing water shortages due to rivers and wells dry up, but several springs on the hillside still supply water for public purposes. Moreover, the area in Tanjung Rusa is a lowland area. The location also very close with the beach, and therefore the sea water intrusion is frequently occured in the areas associated with swamps and tidal sea water. If the source of ground water decrease in the long run, the seawater intrusion will continue to occur and will pollute water sources which will affect the life in Belitung Island. Not only impacted human, the lack of ground water resources could impact the surrounding living organism. The ecosystem could encounter the changing landscape of weather conditions and various kinds of disturbance, but whatever the disturbances, it will impact the individual organisms and species. Further, rapid and extreme disturbances can have major and long-lasting ecological impacts.

The need for *secure access* cause people demand their right to get what they need. According to one of ecological expert who conducted a study in Belitung, the criteria related to water resources is the closest one to the needs of society, and the most practical and feasible to be implemented. In addition, the conservation of wetland areas or water sources to provide benefits to the ecosystem such as flood control, reduce pollution, are also believed to maintain the native species (Indrawan *et al.,* 2007). Criteria of the conservation of water resources is based on ecosystem approach principles that revealed by Grumbine (1994), namely the principle of maintaining ecological and evolutionary processes that took place among the hydrological cycle.

Criteria on Biodiversity Conservation and Protection Area.

Criteria 1, related to the existence of conservation for important area that marked by the status of the area, the authenticity of communities, ecosystems and the existence of endemic flora and fauna, rare and endangered species, have a high priority after the criteria 7 (water resources). Moreover, criteria 2, regarding the protection of flora and fauna endemic and restricted range and rare or endangered species based on existing regulations and also to various stakeholders, have a priority after criteria 1 and 7. These criteria are very likely to be applied and the value is considered as important since the status area and the

regulation concerning biodiversity conservation and protection area are already defined.

Criteria 4 which is the preservation of temporarily key habitat for some individual and population are considered less suitable for the island of Belitung and need to be modified. Fauna in Belitung Island, such as *Tarsius bancanus saltator* is the animal with large territory area that are difficult to trace, and most of animals that live in Belitung is not a big animals that have an easily traced territory area. Therefore, it is needed a more permanent key habitat. With the provision of a more permanent habitat for existing wildlife, it is hoped to maintain the presence of animals that living in oil palm plantations.

The proposed alternative that very potential to be implemented effectively is related to criteria 7 about the conservation of water source area. The alternative will design the re-vegetation along the river basin. With this re-vegetation of border rivers, it will have a function as a wildlife corridors that connect the various different ecosystems along the river basin. This is consistent with the concept of conservation, namely to allow plants and animals to spread from one region to another region, as well as allowing gene flow and colonization of suitable habitat. This corridor could enhance the survival of individuals and animals that exist by providing a source of water and food (Indrawan *et al.,* 2007).

The biodiversity conservation is the criteria which have a priority in the existing sustainability criteria, both in national and global scale (RSPO, 2008; Cramer *etal.,* 1997; RSB, 2009; IUCN, 2009). The meaning of biodiversity is often seen and assumed as the local species richness, therefore, the richness of species or processes that can maintain species richness is always used as a management priority (Stork *et al.,* 1997). We cannot optimize biodiversity unless we can agree on its meaning, and their importance among other priorities. Therefore, the various meanings of biodiversity conservation will vary according to what is perceived as a priority respectively (Sheil *et al.,* 2004).

The principle of these criteria is being under the umbrella principle which defined by Grumbine (1994) in which ecosystem approaches to manage natural populations who may live *(viable population)* in situ. Conservation of the natural type *Lviable native species),* management of natural disturbances, reintroduction of natural species, to minimize invasive species, representing variations of existing natural ecosystems is one of the approach to create an ecological integrity.

The application of the criteria that related to biodiversity is also getting a challenge when viewed from the perspective of environmental ethics. Based on the anthropocentric approach, to implement conservation associated with these prudential, it should be proved what benefits that will be obtained if we conducted the conservation of habitats and species (Alexander, 2008). The burden to provide evidence of such benefit; is a challenges in the application of ecological criteria that will support the creation of sustainable oil palm production.

Criteria on Conservation of Endangered Ecosystems and Environmental Services Provider.

The criteria about the conservation of rare ecosystems and environmental services providers, are under the principle of representing the different variations of existing natural ecosystems in protected areas. Based on the results, criteria 3, with particular regard to heath forest ecosystem considered have a low priority by stakeholders, because the heath forests itself has no real *tangible* economic value for the surrounding communities based on stakeholders perception, but since the heath soil (which is considered to be infertile) can be planted with oil palm, it perceived as a good solution to utilize this type of land. However, this paradigm will endanger the existence of heath forest on the island of Belitung, because the soil in heath forests will be degraded very rapidly and turn into the sand when the vegetation cover on it are removed, thus making it highly susceptible forest type (Whitmore, 1989). Thus, it is need an explanation for all stakeholders about the status of the heath forest ecosystem, and the possible impact

if it is continued replaced by oil palm plantation. The criteria related to this have to define clearer and reliable so it can be effectively implemented.

In connection with the protection of environmental services, criteria 10 for the conservation area that serves as a bulkhead to land and forest are considered as important by the stakeholders. The reason is because the forest fires often occurred in this region since the people still used the slash and burn methods for clearing forests. Criteria regarding these bulkhead land considered have a high priority because it related to the safety of all employees in plantation area. In addition to a well- balanced and realistic management plan, there must be a focus on defense; what precautions are to be taken against threats (Sheil *et al.*, 2004). The bulkhead land is one of example in the criteria that addressing threats.

Criteria 6 (planting on erosion-prone areas) and 9 (planting in accordance with landscape ecology and the existing topography), are considered to be integrated into a single criterion since it has the same idea and could be under the principle of maintaining ecological and evolutionary processes (Grumbine, 1994). The prevention of erosion and planting in the appropriate landscape ecology is believed as one of the maintenance of natural forms so that ecological processes will not be disturbed. Asdak (2007), explained that a large water velocity; length and uninterrupted slope thus concentrated in narrow channels have a greater potential for erosion. This condition is in line with the ecological characteristic in Belitung.

Criteria S (Conserving the natural landscape area within the plantation), deemed as unclear criteria by all stakeholders. These criteria require further explanation regarding the distribution of natural landscapes such as what and what area that should be conserved. Because of this unclear statement, stakeholders consider thiscriteria is difficult to apply.

Regarding the criteria 8 on flood prevention in the area of plantations, on the one hand have a low priority, because so far, both the government, the employees of oil palm plantation company, as well as local communities, have never experienced flooding on the island of Belitung. On the other hand, environmental practitioners believe this criterion is important, since the streamlining of river are often occurred in this area, and it is will potentially cause flood. The streamlining in this area aimed to accelerate the water to prevent puddle on the surrounding plantations which can disturb the growth of oil palm. This should not be done, because the water flow will be faster and will cause flooding in downstream areas. The natural form or winding river called *meanders* hasincreased resistance to flow, thereby reducing the intensity of the cliff and smashed on the riverbed. This makes the slope of the bottom of the river becomes more ramps and the flow velocity will reduced. Based on this reason, the alignment of the river should be avoided in order to prevent flooding and other impacts.

Based on the set of ecological criteria that have been identified in the first, and have been assessed by the stakeholders, the ecological criteria that will be applicable and have a high priority to be implemented for sustainable oil palm production in Belitung Island can be arranged and sorted in Table 3.

In determining the ecological criteria, the local context played a very important role, because at this scale, the sustainability will be defined based on the priorities and expectations of society in local area (Faaij and Lewandowsky, 2006). Essentially, the specific environmental conditions and the values contained in the area where oil plantation carried out is one important thing to note and cannot be ignored. Moreover, local stakeholders were a crucial element in the process of determining these ecological criteria because it can provide a variety of opinions and perceptions towards a sustainable system (Buhler-Natour and Herzog, 1999). Involving stakeholders will enable process of exchanging information and opinions, so the defining ecological criteria will be easily applied and implemented (Kneeshaw ct a/. 2000).

Table 3. The new ecological criteria that have been modified related to Belitung Island's characteristics and stakeholder's perception.

Criteria 1	The existence of conservation areas as a source of water for daily life such as springs, water bodies such as swamps, lakes and rivers to meet the needs of clean water and latrines for communities and providers of ecosystem services (previously criteria 7).
Criteria 2	The existence of conservation to the important area identified by the status of the area, the authenticity of communities, ecosystems and the existence of endemic flora and fauna, rare and endangered species (previously criteria 1).
Criteria 3	Protection of flora and fauna endemic and restricted range and rare species, endangered or endangered according to national legislation and international (IUCN and CITES) and has a specific function according to the local community (previously criteria 2).
Criteria 4	Conservation for the area that serves as a bulkhead to land and forest (previously criteria 10).
Criteria 5	Preservation of rare ecosystems that function as a provider of environmental services for the other subsystems (previously criteria 3).
Criteria 6	Preservation of key habitats and the areas that became the path that connects the activities of animals of one area with other areas (corridors) (previously criteria 4).
Criteria 7	The plantation in the areas based on appropriate landscape ecology and topography (previously criteria 6).
Criteria 8	There is an effort to prevent flooding in the surrounding plantation areas (previously criteria 8).

The use of natural resources and spatial changes should always consider the carrying capacity and surrounding environment. From the case studies conducted in Belitung Island, the development of ecological criteria can be applied broader by utilizing the concept of ecoregion. Ecoregions in Indonesia is divided into five parts, namely Sumatra, Balinusa (Bali, East Nusa Tenggara, West Nusa Tenggara), Sumapapua (Sulawesi, Maluku and Papua), Java, and Kalimantan. The ecoregion concept is expected to integrate inter-regional policies and incorporate environmental considerations in policy development and oversight (Kompas, 2010). Another case study in the same ecoregion will create specific criteria for Ecoregion of Sumatra. More broadly, development of criteria can be done for Indonesia by conducting case studies in five ecoregion.

CONCLUSION

This case study conducted to determine specific ecological criteria in Belitung Island in order to operationalize the sustainability concept. Based on the case study, the criteria have been built by the ecological characteristics of Belitung Island and also by the information and judgement by stakeholders and local communities.

The ecosystem approach in this study, act as an umbrella concept for determining the ecological criteria. The idea of ecosystem approach which integrate land, water, biodiversity and its interaction with human, provide holistic management concept which necessary for sustaining resources in a complex ecological or political landscape (Clark & Minta in press in Grumbine, 1994). The analysis of the relationship between function and process palm oil production with environmental balance allowing proper management, and this can be poured in ecological criteria as a guideline. Consideration of these ecological criteria will provide economic benefits and minimize social conflicts in relation to the environment so that sustainable oil palm plantation can be achieved.

In general, the rank determination and determination value approach is used as an initial screening tool, and this technique is a great way to filter criteria which have a low priority level. Although some criteria seen as low or less important than another, the further study of

this criteria and the repeatedly of the criteria assessment can give more information regarding this criteria and probably can add more criteria which consider as important in the future. The criteria and indicator need some repeatedly assessment to be ready for application in the field. However, the perfection of what constitutes ideal is hard, but the improvement is still reliable.

The development of the ecological criteria will face some potential barriers such as limited resources, especially financial problems. C&I have troubling practical, conceptual and ethical limitations. Many ecological criteria and indicators promoted by C&I sets are costly and of dubious value if their purpose is to cost-effectively improve management (Sheil *et a*1., 2004). Therefore, the ecological criteria for sustainable oil palm production in this study, would be more appropriate when applied to large scale oil companies and there is need more study to define the particular ecological criteria for small scale plantation area.

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