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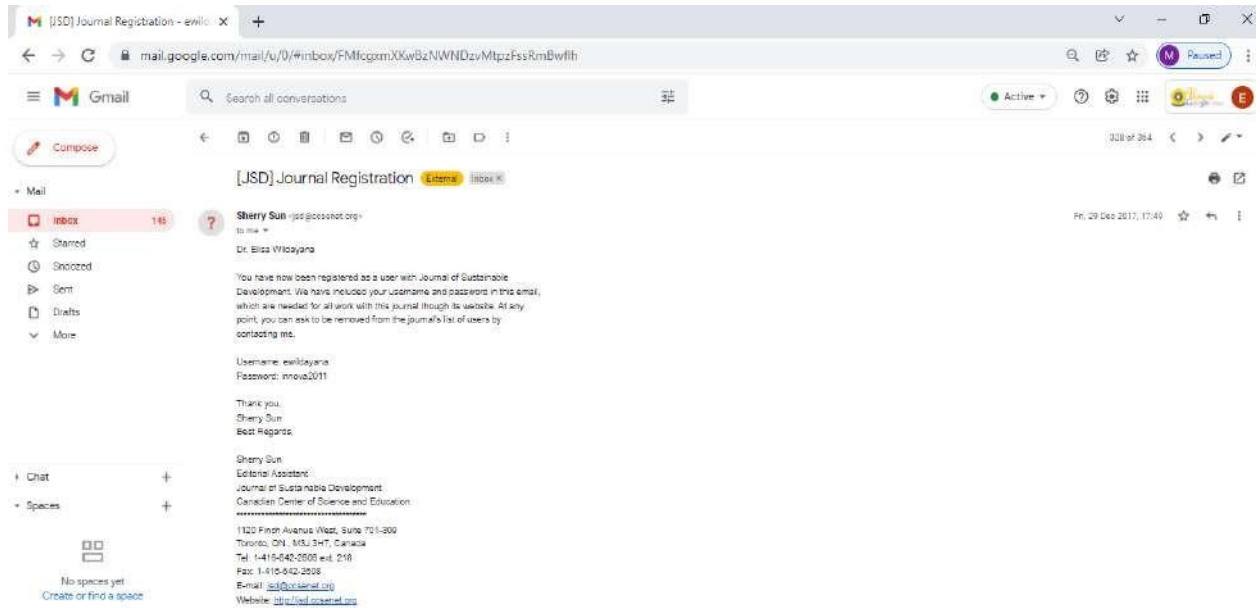
Penulis : *Elisa Wildayana**, M. Edi Armanto

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1	Bukti Konfirmasi Registrasi ke Journal of Sustainable Development (JSD)	29 Desember 2017
2	Bukti Konfirmasi Manuscript ke Journal of Sustainable Development (JSD)	30 Desember 2017
3	Bukti Konfirmasi Submission Acknowledgement dari <i>Journal of Sustainable Development (JSD) Publishing</i>	31 Desember 2017
4	Bukti Konfirmasi Review Results dari Journal of Sustainable Development (JSD) Publishing	22 Januari 2018
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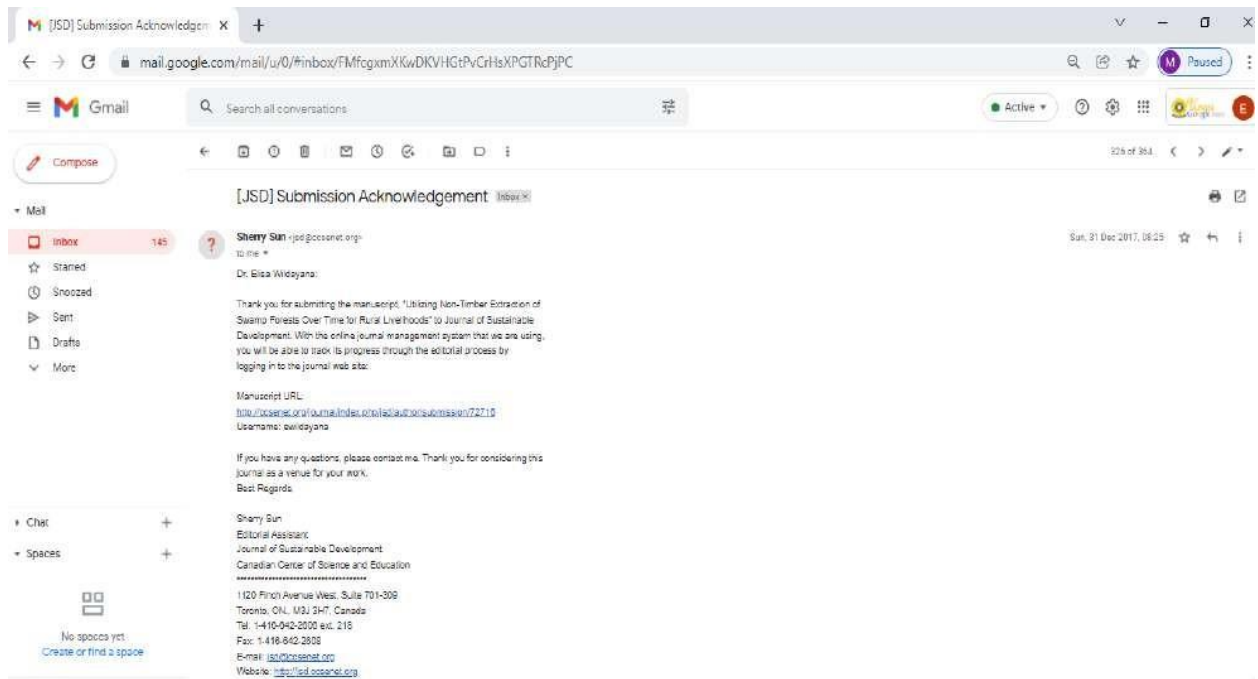
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2 Attachments

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5=Excellent 4=Good 3=Average 2=Below Average 1=Poor	
Items	Grade
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Soundness of methodology	1
Evidence supports conclusion	1
Adequacy of literature review	2
❖ Strengths	
<ul style="list-style-type: none"> ✓ Interest and originality of the issue 	
❖ Weaknesses	
<ul style="list-style-type: none"> ✓ Methodology and its description are really concise and the experimental research is not demonstrated in the results section ✓ Results and discussion section is very long but results are not linked to specific questions, analysis of variance is mentioned but data are not showed, only narrative is offered. There is not discussion which means comparison with other contexts and results discussion. ✓ No discussions and conclusions: only five lines summarizing the situation 	
❖ Suggestions to Author/s	
See the comments attached in the file of the manuscript	

Utilizing Non-Timber Extraction of Swamp Forests Over Time for Rural Livelihoods

Abstract

The research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods. This research was carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra by using factorial design in complete randomized design (CRD factorial design) with two treatment factors. The first factor is farmer tribe and the second factor is time (year). The collecting data were analyzed by using two-way ANOVA and tested by Tukey Posthoc test at level 5%. The research resulted that before 2000, rural communities could be mentioned to be relatively concerned about the status of forest and land resources because they have utilized forest and land resources following customary regulations. Various types of products extracted by priority are fuel material, food sources, medicine and pharmacy, raw materials for handicrafts, structures and other uses. After the year 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, thatching grass, woven mats (from *purun*), rope webbing, leaves, resins, dyes, manure and others.

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Key words: Utilizing, non-timber extraction, swamp forests, rural livelihoods

1. Introduction

Increasing population growth is mentioned as an unavoidable fact especially in developing countries and has an impact on increasing human needs for clothing, food and housing (Armanto et al., 2017a; Limba et al., 2017). Thus it is increasing pressure on forest and land resources, so that without realizing the swamp forest and lands are seriously threatened their existence due to degradation through programmed government policy and private sectors as well as rural community (Armanto et al., 2013; 2017b; Armanto & Wildayana, 2016).

Non-timber forest products come from tree parts or plants and include all biological diversity except timber, which are extracted from forests having special properties for human uses (Barati et al., 2017; Dzidza et al., 2017). These forest products include food, medicines, spices, resins, rubber, ornamental plants, animals and products produced by animals (e.g. fishes, swallow nests, honey, etc.), rattan, bamboo and fibers e.g. *purun* (*Eleocharis dulcis*) and *pandan* (*Pandanus sp*) for making woven mats. They can be needed by the forest community (communities living around the forest), sold for an industry or for its own needs. Its collection does not require complicated licensing as in timber harvesting and forest communities are generally free to collect and to utilize non-timber forest products. They are not prohibited to collect and utilize them, except within protected forests and nature conservation areas. Non-timber forest products are utilized as rural livelihoods for millions of forest communities (Fobissie et al., 2017; Lu, 2017). They utilize non-timber forest products for their directly consumptive needs, such as wild animals, tubers, fruits, vegetables, medicines, firewood and others, or for making money such as rattan, resin, honey, and others. All non-timber forest products have the same characteristics that are excavated by communities in and around forests using simple technology (Mugisha et al., 2017; Armanto et al., 2016).

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Before 2000, farmers in swamp forests have developed agriculture around the forest according to local initiatives, while agriculture alternative was very limited (Adriani & Wildayana, 2015; Departemen Kehutanan, 2007). Rural community was aware that their life was strongly determined on available forest and land resources, so that they have appreciated any component of the existing natural resources and also realized that degradation of forest and land resources will lead to drought (Sarno et al., 2017; Wildayana, 2017). Drought will cause their agricultural productivity to decline sharply because water is needed in each stage of the farming process. In addition, the rapid rate of land degradation is determined as an accumulation of population growth that causes increased pressures on lands, less successful reforestation and lack of support for land and water rehabilitation technologies (Firmansyah et al., 2016; Udoh et al., 2017).

Generally rural community in South Sumatra had local initiatives in interacting with forests, land and water. However, the local initiatives have received fewer acceptances from the government and less recognized by customary and territorial rights (Wildayana et al., 2017; 2016a). Thus the local initiatives

should be developed with respect to commodity zoning; competition and market demand on the other hand the challenge to swamp forest and lands is very high. Local initiatives controlled by customary rights were effective in controlling forest and land degradation because these local initiatives had been able to establish interactions between rural communities with forest and land resources and was still firmly held by rural communities.

After 2000, landuse changes in the swamp forest were initiated by the government by granting consent permits for the use of forests and swamp forest area for oil palm plantations, then large lands were cleared and opened regardless of preservation because the land clearing was done by burning. The fire will change the thorough ecosystem not only in the bio geophysical aspect, but also in the social and cultural aspects of society. Because the area is already opened and access to forests becomes easier, rural communities become triggered to participate in excessive forest extraction in order to benefit as large companies do. This implies the land in danger of being not only from large companies, but also by local government (Wildayana et al., 2016b). They have done land clearing without regarding to environmental aspects. The rural communities also have been triggered to extract forests to gain a share of the benefits without regard to environmental aspects also, such as fishing with electric and toxic strum, so that almost all aquatic biota become threatened by its existence or open forests to farm in areas that are easily accessible by fire. This causes land cover to decrease and lead to degradation of land and water resources.

The direct impact is felt by rural communities because the forest and land has been degraded and water catchment function is decreased which decrease of agricultural land productivity. The difficulty of clean water is a major factor that encourages the awakening of public awareness of the importance of the region (Yosada et al., 2017; Tavakoli et al., 2017; Pangerungan et al., 2017). That is, well-preserved forests will bridge the ongoing rains that can support all life components of communities. The downfall will enable the community to diversify the crops and farming patterns on managed lands, increasing productivity and income. Based on the above problems, the research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods. The results of this research can be used as a thought contribution to the government in making policies for the conservation of remaining swamp forest and land resource.

2. Materials and Methods

This research has been carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra. Demarcation of OKI District, South Sumatra Province, Indonesia is given in Figure 1. This research was characterized as an experimental research by using factorial design in complete randomized design (CRD factorial design) with two treatment factors. The first factor is farmer's tribe and the second factor is time (year). The first factor consists of two tribes (namely local communities and the newcomers), while the second factor consists of four year levels, namely 1970; 2000; 2017; and 2050. Techniques of collecting data were using questionnaires and the number of respondents was expressed as replication, then conducted by intensive study of various literature and in-depth interviews to key informants related research focus. Data analysis was performed by using variance analyses and tested with post hoc test using Tukey test. The research scope is focused on the aspects, such as the experiences of rural communities living around the area, the utilization of forest resources by rural communities, the rehabilitation and conservation of lands, and the revitalization of forest and land resources.



Figure 1. Demarcation of OKI District, South Sumatra Province, Indonesia (Source: Google website)

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3. Results and Discussion

This research has discussed the condition of rural communities around the forest; extraction of forest resources for fuel materials; food sources; medicine; handicraft; structure and fiber; and revitalization and cultural conservation.

3.1 Condition of Rural Communities around the Forest before 2000

Before 2000, the life of rural communities around the forest could be said to be in harmony with nature. The existence of community initiatives to pay attention to all ecological components was related to forest functions as an important resource for their life. To manage utilization of forest, land and water resources, local communities have built customary agreements to prohibit communities to clearing forest by burning. This agreement governs the rights and obligations of each individual, including those violating the customary sanctions. Awareness of the community has been built and the local rules allowed efforts to conserve the forest area in a sustainable manner.

The farming pattern was developed by rural communities around the swamp forest area to carry out sustainable utilization of forest, land and water resources. This customary arrangement encourages communities to be the most important part of any effort to conserve forest and land resources. The rural community were still inherits socio-cultural values in environmental management, where the life concept of triangle harmonized the balance of life between humans, the universe and God Almighty. Life balance between these three components become the central point of all the behavior of rural community in their daily life.

Villages located around the forest could be determined as buffering zones and they have utilized forests as an income source of households. Some non-timber forest products are often utilized namely purun, honey, fish and fruits. To increase the socio-economic benefits, some inputs of forest management should be provided through the development of social forestry models by empowering rural communities. Reinforcement of agro-forestry swamp and mixed agriculture could be done through agricultural commodities, forestry, plantation and livestock farming, so that management approach could be done thoroughly by accommodating various stakeholders, including community, government and customary leaders. Direct use of swamp forests for rural livelihoods is presented in Table 1.

Table 1. Direct uses of swamp forests for rural livelihoods

Forest products	Harvested material from forest area	Priority
Fuel materials	Firewood; charcoal; wood sticks	1
Food sources (animal products)	Bush meat; fishes; shrimps; honey; wild animals; wild birds	2
Food sources and spices (plant products)	Wild fruits; vegetables; foliage leaves for fresh vegetables; mushroom; nuts	3
Materials for handicrafts	Thatching grass (<i>atap daun</i>); woven mats (<i>tikar purun</i>); baskets; brooms; vines; dyes; rope webbing; dyes; and others	4
Structure and fiber	Construction materials; poles; sawn wood; bamboos; timber	5
Medicine and pharmacy	Drugs (medicines); utilitarian; ritual materials	6
Other Uses	Agroforestry; plantations; agriculture; fodder; leaves; resins; manure and others	7

Source: Field survey results (2017).

Income of household from forests was obtained by forest extraction, such as honey, fruits, ropes, game animals, medicines and others. Rural communities often utilized the materials for their own use as well as for the common good in their social communities. The income from forests was not always assessed by the amount of money how much they earned because they did not always sell, but they used for the benefit of their household and communities.

The life of rural communities around the forest **after 2000** could be said to change completely. Their dependence on forest extraction results was diminishing and they were dependent on oil palm plantations and industrial plantation forest (HTI), which planting acacia trees (*Acacia crassicarpa*). They work on large plantations and HTI as harvesters, gardeners and day laborers. Fishing has been done very little since rivers and public waters no longer provide fish, most of the fishery resources have been destroyed because of fishing practices that do not conserve the environment (using poison and electric shocks).

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3.2 Extraction of Forest Resources for Fuel Materials

Fuel materials are originated from organic materials from forest resources to generate energy, for example charcoal; firewood; wood sticks and others. Until 2000, there was no significant difference between forest extraction in 1970 (about 24.59%) and 2000 (about 22.58%), but there was a significantly different compared to 2017 (9.24%). It was predicted that forest extraction for fuel materials was not significantly different in 2050 (7.23%). The extraction of forests tended to decline continually from year to year due to the reducing forest area and biodiversity (Table 2).

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Until 2000, rural communities took firewood in particular from vegetation type that has been dried and done regularly around the forest area. Almost all types of firewood were derived from stems and small twigs and easily moved by human hands. Big wood species were not taken because they are too heavy and require a lot of time to move the wood. Activity to take firewood was not done at all times (not intensely, just once a week), besides that in garden area provided also available firewood, for example mahoni branch, dadap, shade tree, bamboo and others. This way did not put pressure on the forest and it is preserved sustainably.

Table 2. Non-timber extraction changes over time of swamp forests

Year	Volume harvested (%)						
	A	B	C	D	E	F	G
1970	24.59 ^a	17.24 ^a	15.35 ^a	9.11 ^a	9.31 ^a	9.01 ^a	15.39 ^a
2000	22.58 ^a	16.76 ^a	12.31 ^b	9.43 ^a	9.88 ^a	9.11 ^a	19.93 ^a
2017	9.24 ^b	11.92 ^b	10.41 ^c	10.67 ^a	9.76 ^a	8.69 ^a	39.31 ^b
2050*	7.23 ^b	5.04 ^c	4.57 ^d	4.73 ^b	9.88 ^a	9.11 ^a	59.44 ^c

Note : A (Fuel materials); B (Food sources, animal products); C (Food sources and spices, plant products); D (Medicine and pharmacy); E (Materials for handicrafts); F (Structure and fiber); and H (Others including agriculture, plantation, HTI etc.).

*/ data are estimated based on landuse changes from imagery images

Source : Field survey results (2017).

After 2000, there has been changed globally because some swamp forests was fully cleared by private large company of large plantations and HTI where land clearing was done heavy machine and fire, so most of the forest area was converted to oil palm or HTI.

3.3 Extraction of Forest Resources for Food Sources

In general, the non-timber extraction of swamp forests for food sources can be divided into two groups, i.e. food sources originated from wild animals and food sources derived from plant products. For food sources derived from wild animals, the rural community around the forest area has hunted wild animals or cached fish in rivers, lakes or public waters.

Until 2000, various types of animals were often hunted for having meat such as birds, wild chickens (*Gallus gallus*), alap-alap (*Accipitridae sp.*), weasel (*Cynogale bennetti*), wild deer, honey, swallow nest and other types of animals. Although not consumed by the local population, the bird's nest is one of the most valuable commodities to sell. The skin, bones and teeth of animals can be made into handicrafts such as bags and necklaces. Wild animals also hunted for being pests for agricultural crops are wild pigs (*Sus barbatus*), ferrets, mice, snakes, and others.

Various types of fishes are caught, namely gabus fish (*Channa Striata*), baung (*Mystus nemurus*), patin (*Pangasius sp.*), palung (*Hampala macrolepidota*), tawes (*Barbodes gonionotus*), toman (*Channa micropeltes*), keting (*Mytus nigriceps*), kepras (*Puntius binotatus*), derbang (*Puntius pinnauratus*), lampan (*Barbodes schwanenfeldti*), seluang (*Osteochillus schlegeli*), lele (*Clarias gariepinus*), belut (*Monopterus albus*) and other types of aquatic animals. The results of hunting and fishing were generally used to fulfill their own needs of animal protein.

Food sources derived from plant products can produce carbohydrates derived from tubers, such as gadung (*Dioscorea hispida*), keladi (*Caladium sp.*), talas Padang (*Colocasia gigantea*), ubi pasir (*Dioscorea pentaphylla*), uwi (*Dioscorea alata*) and wild banana (*Musa sp.*) and other species that grow wild. The benefits of forest as a source of vitamins are obtained by taking vegetables from forests such as mushroom (*Auricularia auricular*), nail vegetables (*Neprolepis bisserata*, *Sternoclaena palustris* and *Diplazium esculentum*), oyster mushroom (*Pleurotus ostreatus*) and others.

Forest products are often used to meet their own needs. Fresh fruits are obtained from forest area including coconut (*Cocos nucifera*), mango (*Mangifera indica*), jackfruit (*Artocarpus integra*), kesambi (*Scheilera olease*) and various other fruits contained in the forest. Periodically, the rural community also takes the ingredients for cooking in the forest such as daun Salam (*Eugenia sp.*), ginger (*Zingiber sp.*), serai/sere (*Cymbopogon citratus*), kemiri fruit (*Aleurites moluccana*) and other types.

The results of the variance analyses showed that there has been a decline in the volume of forest products harvested for food source by year. The volume of material harvested in 1970 (17.24%) was not significantly different from the volume of material harvested in 2000 (16.76%) and showed significantly different with the extraction of forests harvested in 2017 (11.92%) and significantly different from the forest extraction of 2050 (5.04 %). The same extraction of forest resources for food sources was derived from plant products. This decrease in forest extraction volume was mainly due to the decreasing forest area, so that the biodiversity living in the area is also decreasing, thus affecting the amount of non-timber extraction.

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Some rural communities doing fishing in that are not sustainable ways, such as fishing with poison and electricity. Both ways caused the fishery stock to be destroyed and fishery resources are not able to be regenerated. According to rural community, after forest areas are easily accessible, and then fish catching by poisoning was mostly done by newcomers. It means after 2000 that large companies undertook land clearing for oil palm plantations and HTI. In fact rural communities are already aware that these methods of catching fish will threaten their life, but they do not have the ability to ban such illegal acts or they cannot remind them to avoid fishing by poisoning and electrocution. The reminding of the rural communities was positively responded by newcomers; even such it may trigger clashes among rural communities with newcomers from outside the village.

3.4 Extraction of Forest Resources for Medicines

Rural communities still have traditionally dependence on forests as a source of medicines because they are more likely to take traditional medicines than to seek treatment at a health center or to take medical medicines unless the disease is very serious, then the patient is taken to the health center. For medicinal products it is quite a bit difficult to identify products that are really only for medicine, since some products are usually used for daily use as well as for medicine, such as spices, resins, nests of swallow birds, and so on. The diversity of plant species taken from forests and used for medicine is presented in Table 3.

Various types of medicinal plants are mixed for various uses such as bathing, drinking, spraying, or to compress in case of fractures. There are materials that can be used directly and some are dried first and then stored. Materials derived from leather and wood roots, usually stored because it is not easily damaged, but for the foliage is usually directly used, i.e. by boiling to be drunk or used for bathing.

Table 3. Diversity of plant species taken from forests used for medicine

Type of vegetation	Utility for rural community
Jambu biji (<i>Psidium guajava</i>)	Treat diarrhea
Jarak (<i>Jatropha curcas</i>)	Childbirth and treat dizziness
Pulai (<i>Alstonia scholaris</i>)	Malaria, paralysis and rheumatism
Kunjur (<i>Cassia fistula L</i>)	Headache, back pain, childbirth and clean dirty blood
Kunyit (<i>Curcuma domestica</i>)	Wash blood, clean dirty blood
Kelor (<i>Moringa oleifera</i>)	Decrease the placenta, increase milk production and improve child health
Kumis kucing (<i>Orthosiphon stamineus</i>)	Asthma, shortness of breath and diabetes
Waru (<i>Hibiscus tiliacus</i>)	Pain ear, treat cuts and prevent infection
Sirih hutan (<i>Piper amboinensis</i>)	Fractures, catalyst for spray medicines
Mengkudu (<i>Morinda sp.</i>)	Diabetes, liver, heart, high blood pressure, asthma and indigestion

Source: Field survey and direct interview with respondents (2017).

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The results of the variance analyses showed that there is no decrease in the volume of forest products harvested for medicine materials by year. Until 2017, there was no significant difference between forest extraction in 1970 (around 9.11%) and 2000 (about 9.43%) until 2017 (around 10.67%). It was predicted forest extraction for medicine materials was significantly different in 2050 (4.73%). This is due to the decreasing biodiversity of the forests and the extent of the area was also declining sharply. In addition to

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rural communities increasingly aware and believe in medical treatment, so if they are sick, then they will visit the nearest health center.

3.5 Extraction of Forest Resources for Handicraft Materials

Various forms of handicrafts can be made by rural communities whose basic materials are extracted from forest products. Wild plants are usually used as fiber, such as *purun* and *pandan* to make mats, baskets, plates of rice, hats and others. Rural communities often use banana leaves to wrap food, nipah leaves and betel nuts for the house roof especially for houses in the garden, and pandan leaves for handicrafts. Handicrafts made from *purun* and *pandan* leaves are mats, either small size (1x2 m) for food mat or table cloth or large size commonly used for bedding. *Purun* and *pandan* leaves are also used to make a hat as a protective head while in the garden or rice fields. The leaves are very little found around the yard or in the garden.

In addition to the daily life of rural communities, they need rigging as a binder obtained from bark, rattan, and palm fiber from several palm trees. In everyday life communities need ropes to tie livestock, binding goods or building custom homes. Most rope materials are taken by rural communities from forest areas. The public distinguishes the rope type that is used for instantaneous use with strap types for long-term use. This type of rope for instantaneous use is taken directly used by residents to bind goods or other objects for short term interests. As for the type of rope for long-term use, usually the rope obtained is processed first to become stronger and tidier by spinning, and then it was used to bind cattle or building construction equipment.

The results of the variance analyses showed that there is no decrease in the volume of forest products harvested for handicraft materials by year. It is not significantly different between forest extractions from 1970 to 2017. It was predicted that forest extraction for handicraft materials was also not significantly different in 2050. This is because rural communities are less interested in handicraft anymore because considering the handicraft work is less desirable by market and society difficult to sell handicraft products, so the result of making handicraft only to meet the needs of their own household.

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3.6 Extraction of Forest Resources for Structure

Rattan and bamboo were collected periodically to meet the needs of building materials, making household appliances such as nyiru, baskets, bamboo chairs, livestock pens, and for other uses. Rattan is a kind of vines with the shape of a round stem with a length of about 10 to 60 m. Due to its strong, long, flexible and durable properties make rattan a versatile raw material. Whole rattan is usually used as furniture, household appliances and other accessories. Medium rattan skin can be used as handicraft products such as baskets, bags, mats, etc.

There are many types of bamboo. Although the nature of bamboo is not like rattan, but many bamboo is also used to make furniture, handicraft items, homes in villages, bridges, household appliances, and others. Bamboo is used to make house walls (*gedek*), yard fence, traditional house construction and cot (bed). They also use bamboo to make fish traps in rivers, stem the water, drain water and make simple bridges. The community also developed bamboo plants around the yard, settlements and farming as well as plantation area, so it does not depend on the existing bamboo resources in the forest.

The results of the variance analyses show that there is no change in the volume of forest products harvested for structural and fibers materials by year. There is no significant difference between forest extraction from 1970 to 2017 and predicted forest extraction for handicraft materials is also not significantly different in 2050. This is because rural communities are less interested in extracting structural and fiber materials from forest areas due to forest areas has provided less such materials, in addition to that there are many other materials that can be used as a subsistence of material derived from forest areas. In addition, the general public is less interested in materials that come directly from forest areas, urban communities prefer subsistence materials, so that the extraction of structures and fiber coming from forest areas is only to meet the needs of their own household.

3.7 Extraction of Forest Resources for Other Uses

Extraction of forest resources for other uses was mostly harvested other than those categorized above, for example yields of agro forestry, plantation, ornamental plants, chemical materials and other activities. Ornamental plants are usually used for home decoration, flowers are also used for perfume raw materials, also for dye (for dyeing cloth). Some flowers have high values, namely various types of orchids, which are admired for its beauty and various types of fern plants. But many species of orchids

are already threatened with extinction, including black orchid. Orchid plants can usually be cultivated in the yard or orchid garden. To produce chemical materials, there are several ways, namely by tapping directly from the tree and then taken out fluid (usually a sap). Another way is to distill or mix with the solvent, especially resin, camphor, and others.

The results of the variance analyses showed that there have been many changes in the volume of forest products harvested by year. It was significantly different between forest extraction in 1970 (about 15.39%) compared to 2000 (about 19.93%) and significantly different from 2017 (39.31%). It was predicted that forest extraction for other uses was also significantly different in the year 2050 (59.44%). The rural communities are less interested in taking other products from forested areas because the forest area has less supply of these materials, besides that there are many other materials can be used as a subsistence of material derived from forest areas. In addition, they are already dependent on palm oil plantations that are more promising for their future life.

3.8 Conservation and Revitalization of Forest and Land Resources

In management of forest and land resources, two approaches are commonly known, namely the vegetation approach and the civil technical approach. A mixed swamp forest and lands agriculture is mentioned as the vegetation approach in land rehabilitation. The use of vegetation methods has several advantages, namely: to protect the soil structure from kinetic energy of falling rain granules; to protect the soil from surface runoff strength; and to increase the capacity of soil infiltration and the ability to retain groundwater, so that the amount of groundwater absorbed into the soil is increased more and more. Further emphasized several ways included in this approach are divided into several ways, i.e. reforestation; planting by contour; crop rotation; maintaining grass or leguminous plants; covering the ground surface with mulch and agro forestry practices.

3.8.1 No burning for land clearing

There is no proper solution to clear the land other than by burning because land clearance by burning is considered the easiest, most efficient and efficient way. To reduce the negative impacts of land burning, the burning of the land is done with due regard to local wisdom and is always closely watched, so the smoke that arises from the burning of land does not cause problems for other community activities. Before burning, farmers usually dig a hole bordering area of land to be burned and the area of burned land is also relatively small, where the most extensive one hectare only. When carrying out the burning of land is always maintained, so the fire does not spread to other communities' land. If the fire spread to another person's land, the one who burns will be subject to sanction or customary law. Meanwhile, the cost to pay for sanctions or customary law is enormous, and very difficult to meet by rural communities.

The rest of the combustion will be used as fertilizer for the plants. The land is burned and clean, and then it will be planted with various types of plants ranging from rice, fruit and vegetables. If the peatlands have been burned, of course it was very difficult to extinguish and cause a thick haze thick enough. In the event of a fire on peatlands and land owned by the company can cause smoke haze that disrupts the activities of the community. The land burned by rural communities does not cause smoke haze that can disturb the activities of the community.

3.8.2 Planting of Multi Purposes Tree Species (MPTS)

MPTS species are plants that have very diverse uses or are called multipurpose trees because they are capable of supplying food (e.g. fruits, nuts, or vegetables); firewood; increasing soil fertility (e.g. nitrogen, soil organic matter); providing shade, habitat, part of living fence, windbreak and others. When multipurpose trees are planted, a number of needs and functions can be fulfilled at once. Some versatile trees, among others: *Moringa oleifera* plant, where the morphological parts of plants, such as leaves, pods and nuts that can be used as animal feed, medicines and shade functions. The deep coconut (coconut palm) can be used as foodstuff, drinking water, house roof, firewood, broom stick, and shade. Ideally most of the trees found on tropical farms should be multipurpose trees, and provide more benefits to farmers. In general, the versatile tree includes the leguminous household that is able to supply nitrogen into the soil and increase food security.

Rural communities increase the diversity of plant species that have a protected function such as beringin tree (*Ficus benjamina*), acacia (*Acacia sp.*), mahoni (*Swietenia macrophylla*), dadap (*Eritryna sp.*), gmelina (*Gmelina arborea*), bamboo (*Bambusa sp.*) and some MPTS. Rural community also considers to fulfill the needs of livestock feed by developing the types of plants that can be used as animal feed, i.e. turi (*Sesbania grandiflora*), lamtoro or petai cina (*Leucaena leucocephala*), kaliandra putih

(*Zapateca tetragona*), wild pisang (*Musa parasidica*), gamal (*Gliricidia sepium*), kaliandra merah (*Calliandra calothyrsus*), king grass and tubers. The element of soil and water conservation is done not only on certain aspects, but rather it is able to provide space for the development of other sectors such as farms.

3.8.3 Harvesting non-timber products

Some parents teach their children about restrictions on the misuse of forests such as taking wood, destroying saplings and releasing livestock into the forest. With livelihoods in the agricultural sector, the ability to connect forest conservation with water systems can be mentioned as a measure of the existence of ecological wisdom. With regard to soil and water conservation through social forestry approaches, local knowledge about the ways of farming and interacting with forests, soil and water needs to be re appreciated through various tools and regulation of social forestry development by taking into account:

- 1) Policies should be directed with the aim of revitalizing local utilization practices or initiatives in support of forest, land and water management.
- 2) Forest resource management practices should be objectively accommodated by local communities as a foundation for the implementation of forestry sector development in rural areas.
- 3) Rural communities should be the main actors of forest, land and water management processes and can ascertain the direction and objectives of the process.

In order to improve the appreciation and internalization of various agricultural practices of swamp forests by local communities for generations, some considerations are needed to be conditioned as follows:

- 1) The development of crop species should prioritize local crop species that have adapted to various patterns of community utilization along with social, economic, ecological, and rural cultural functions.
- 2) Forest, land and water management approach should recognize and represent approaches on tribes, household, farmer group and others.
- 3) Small scale forest units can be managed collectively by local groups while still providing roles and contributions to each household to contribute to individual management, as well as to be inherited based on customs and inheritance system which applies in rural communities.
- 4) Need revitalization and re-actualization of mixed based swamp forest and lands agriculture including reconstruction of customary rules that support sustainable forest, land and water management.

The successful key in various forest reforestation activities is very clear to the community as the subject of the perpetrator. Without a strong desire and a thorough understanding in the community about the importance of forest sustainability will lead to various reforestation efforts to be hampered, resulting in no results. Therefore, in addition to the review of the technical aspects such as the land and water conservation and rehabilitation aspects described above, it should also be discussed further on the conservation aspect of the culture itself. Socialization will certainly be faced with constraints such as modernization and technological progress and population growth. Therefore, possible steps to be taken include:

- 1) Schools can be utilized as a mediating tool and channel socialization formally optimized its function.
- 2) Government intervention and stakeholders have to invite the mass media, especially television and radio to become a channel of socialization.
- 3) A reward program for communities can be maintained as sustainability at the household level through indicators of community forest development.
- 4) A model village or pilot village in one community around the forest area should be created to stick to local initiatives.

4. Conclusions

Before 2000, rural communities could be mentioned to be relatively concerned about the status of forest and land resources because they have utilized forest and land resources following customary regulations. Various types of products extracted by priority are fuel material, food sources, medicine and pharmacy, materials for handicrafts, structures and other uses. After the year 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, leaves, thatching grass, resins, dyes, manure and others.

Commented [I16]: These are personal ideas of the authors? It seems.....

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5. Bukti Konfirmasi Revisi Manuscript ke Journal of Sustainable Development (JSD) (27 Januari 2018)



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Dear Executive Editor,

Following we send you back our revised paper with title: “**Utilizing Non-Timber Extraction of Swamp Forests over Time for Rural Livelihoods**” to be published in Journal of Sustainable Development. The comprehensive revision was done based on the recommendation of the reviewers.

Perhaps this paper is weak from methodology, but in its content, this paper will provide information to many people about the importance of alignment to the local community. Thus, we really hope that this manuscript can be published in the Journal of Sustainable Development, so that many people will be informed about the condition of swamp forest which already converted to oil palm plantation and HTI (Industrial Plantation Forest) especially for the benefit of local people.

Thank you,

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Dear Sherry Sun,

Herewith we submit our manuscript correction, I added Prof. Dr. M. Edi Armanto as the second author because he has completely corrected this manuscript and funded this research. We hope that the existence of this second author does not violate the rules that have been set by the editorial board.

Our correction in the Word file is determined in RED color and we use our original university name as "Universitas Sriwijaya".

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9. Bukti Konfirmasi Final Revision (25 Maret 2018)



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Utilizing Non-Timber Extraction of Swamp Forests over Time for Rural Livelihoods

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Abstract

The research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods. This research was carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra, Indonesia. The data were collected by direct field observation, intensive study of archive report documents as well as in-depth interviews with the respondents. Before 2000, rural communities could be mentioned to be relatively concerned about the status of forest and land resources because they have utilized forest and land resources following customary regulations. Various types of products extracted by their priority are fuel material, food sources, medicine and pharmacy, raw materials for handicrafts, structures and other uses. After 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, thatching grass, woven mats (from *purun*), rope webbing, leaves, resins, dyes, manure and others. These activities have caused degradation of swamp forest. To minimize the impact of swampforest degradation, the active participation involvement of the rural community and all other stakeholder components is essential to optimize swamp forest management.

Keywords: utilizing, non-timber extraction, swamp forests, rural livelihoods

1. Introduction

Increasing population growth is mentioned as an unavoidable fact especially in developing countries and has an impact on increasing human needs for clothing, food and housing (Armanto et al., 2017a). Thus it is increasing pressure on forest and land resources, so that without realizing the swamp forest and lands are seriously threatened their existence due to degradation through programmed government policy and private sectors as well as rural community (Armanto et al., 2013).

Non-timber forest products come from tree parts or plants and include all biological diversity except timber, which are extracted from forests having special properties for human uses. These forest products include food, medicines, spices, resins, rubber, ornamental plants, animals and products produced by animals (e.g. fishes, swallow nests, honey, etc.), rattan, bamboo and fibers e.g. *purun* (*Eleocharis dulcis*) and *pandan* (*Pandanus sp*) for making woven mats. They can be needed by the forest community (communities living around the forest), sold for an industry or for its own needs. Its collection does not require complicated licensing as in timber harvesting and forest communities are generally free to collect and to utilize non-timber forest products. They are not prohibited to collect and utilize them, except within protected forests and nature conservation

areas. Non-timber forest products are utilized as rural livelihoods for millions of forest communities. They utilize non-timber forest products for their directly consumptive needs, such as wild animals, tubers, fruits, vegetables, medicines, firewood and others, or for making money such as rattan, resin, honey, and others. All non-timber forest products have the same characteristics that are excavated by communities in and around forests using simple technology (Mugisha et al., 2017; Armanto et al., 2016).

Before 2000, farmers in swamp forests have developed agriculture around the forest according to local initiatives, while agriculture alternative was very limited. Rural community was aware that their life was strongly determined on available forest and land resources, so that they have appreciated any component of the existing natural resources and also realized that degradation of forest and land resources will lead to drought (Wildayana, 2017). Drought will cause their agricultural productivity to decline sharply because water is needed in each stage of the farming process. In addition, the rapid rate of land degradation is determined as an accumulation of population growth that causes increased pressures on lands, less successful reforestation and lack of support for land and water rehabilitation technologies (Firmansyah et al., 2016; Udoh et al., 2017).

Generally rural community in South Sumatra had local initiatives in interacting with forests, land and water. However, the local initiatives have received fewer acceptances from the government and less recognized by territorial rights (Wildayana et al., 2016a). Thus the local initiatives should be developed with respect to commodity zoning; competition and market demand on the other hand the challenge to swamp forest and lands is very high. Local initiatives controlled by customary rights were effective in controlling forest and land degradation because these local initiatives had been able to establish interactions between rural communities with forest and land resources and was still firmly held by rural communities.

After 2000, land use changes in the swamp forest were initiated by the government by granting consent permits for the use of forests and swamp forest area for oil palm plantations, and then large lands were cleared and opened regardless of preservation because the land clearing was done by burning. The fire will change the thorough ecosystem not only in the bio geophysical aspect, but also in the social and cultural aspects of society. Because the area is already opened and access to forests becomes easier, rural communities become triggered to participate in excessive forest extraction in order to benefit as large companies do. This implies the land in danger of being not only from large companies, but also by local government (Wildayana et al., 2016b). They have done land clearing without regarding to environmental aspects. The rural communities also have been triggered to extract forests to gain a share of the benefits without regard to environmental aspects also, such as fishing with electric and toxic strum, so that almost all aquatic biota become threatened by its existence or open forests to farm in areas that are easily accessible by fire. This causes land cover to decrease and lead to degradation of land and water resources.

The direct impact is felt by rural communities because the forest and land has been degraded and water catchment function is decreased which decrease of agricultural land productivity. The difficulty of clean water is a major factor that encourages the awakening of public awareness of the importance of the region (Tavakoli et al., 2017; Pangerungan et al., 2017). That is, well-preserved forests will bridge the ongoing rains that can support all life components of communities. The downfall will enable the community to diversify the crops and farming patterns on managed lands, increasing productivity and income. Based on the above problems, the research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods.

2. Materials and Methods

This research has been carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra. Demarcation of OKI District, South Sumatra Province, Indonesia is given in Figure 1. The data were collected by direct field observation, intensive study of archive report documents as well as in-depth interviews with the respondents. The process of collecting data was made through participatory approach where researchers took place in daily life of farmers. Techniques of collecting data were using questionnaires and the number of respondents was 377 households of farmers. In-depth interviews to key informants were carried out with key informants, mostly from community leaders consisting of sub-district heads, village heads, neighborhood heads, village leaders as well as the chairmen of NGO (Non-Governmental Organizations). The intensive study of archive report documents came from Government and private institutions, such as the Regional Development Planning Board or NGO as well as University. Collected data were concluded, presented and then analyzed statistically. The research scope is focused on the aspects, such as the experiences of rural communities living around the area, the utilization of forest resources by rural communities, the rehabilitation and conservation of lands, and the revitalization of forest and land resources.



Figure 1. Demarcation of OKI District, South Sumatra Province, Indonesia (Source: Google website)

3. Results and Discussion

This research has discussed the condition of rural communities around the forest; extraction of forest resources for fuel materials; food sources; medicine; handicraft; structure and fiber; and revitalization and cultural conservation.

3.1 Condition of Rural Communities around the Forest before 2000

Before 2000, the life of rural communities around the forest could be said to be in harmony with nature. The existence of community initiatives to pay attention to all ecological components was related to forest functions as an important resource for their life. To manage utilization of forest, land and water resources, local communities have built customary agreements to prohibit communities to clearing forest by burning. This agreement governs the rights and obligations of each individual, including those violating the customary sanctions. Awareness of the community has been built and the local rules allowed efforts to conserve the forest area in a sustainable manner. This study is in line with the findings of Adriani & Wildayana (2015) who saw how the economic growth in the agricultural sector.

The farming pattern was developed by rural communities around the swamp forest area to carry out sustainable utilization of forest, land and water resources. This customary arrangement encourages communities to be the most important part of any effort to conserve forest and land resources. The rural community were still inherits socio-cultural values in environmental management, where the life concept of triangle harmonized the balance of life between humans, the universe and God Almighty. Life balance between these three components becomes the central point of all the behavior of rural community in their daily life. The similar result was also demonstrated by Armanto & Wildayana (2016).

Villages located around the forest could be determined as buffering zones and they have utilized forests as an income source of households. Some non-timber forest products are often utilized namely *purun*, honey, fish and fruits. Armanto et al (2017b) also analyzed various swamp functions to support the livelihood sources of local farmers and surrounding communities.

To increase the socio-economic benefits, some inputs of forest management should be provided through the development of social forestry models by empowering rural communities. Reinforcement of swamp agroforestry and mixed agriculture could be done through agricultural commodities, forestry, plantation and livestock farming, so that management approach could be done thoroughly by accommodating various stakeholders, including community, government and customary leaders. Limba et al (2017) stated how local wisdom principles can be applied in agricultural activities and as a source of local livelihoods. Direct use of swamp forests for rural livelihoods is presented in Table 1.

Income of household from forests was obtained by forest extraction, such as honey, fruits, ropes, game animals, medicines and others. Rural communities often utilized the materials for their own use as well as for the common good in their social communities. The income from forests was not always assessed by the amount of money how much they earned because they did not always sell, but they used for the benefit of their household and communities. Lu (2017) explained there is a relationship between land and forest with human survival.

The life of rural communities around the forest after 2000 could be said to change completely. Their dependence on forest extraction results was diminishing and they were dependent on oil palm plantations and industrial plantation forest (HTI), which planting acacia trees (*Acacia crassicarpa*). They work on large plantations and HTI as harvesters, gardeners and day laborers. Fishing has been done very little since rivers and public waters no longer provide fish, most of the fishery resources have been destroyed because of fishing practices that do

not conserve the environment (using poison and electric shocks). A similar study was reported by Dzidza et al (2017) that it found similar natural phenomena occurring in Ghana.

Table 1. Direct uses of swamp forests for rural livelihoods

Forest products	Harvested material from forest area	Priority
Fuel materials	Firewood; charcoal; wood sticks	1
Food sources (animal products)	Bush meat; fishes; shrimps; honey; wild animals; wild birds	2
Food sources and spices (plant products)	Wild fruits; vegetables; foliage leaves for fresh vegetables; mushroom; nuts	3
Materials for handicrafts	Thatching grass (<i>atap daun</i>); woven mats (<i>tikar purun</i>); baskets; brooms; vines; dyes; rope webbing; dyes; and others	4
Structure and fiber	Construction materials; poles; sawn wood; bamboos; timber	5
Medicine and pharmacy	Drugs (medicines); utilitarian; ritual materials	6
Other Uses	Agroforestry; plantations; agriculture; fodder; leaves; resins; manure and others	7

Source: Direct interview results with the respondents (2017).

3.2 Extraction of Forest Resources for Fuel Materials

Fuel materials are originated from organic materials from forest resources to generate energy, for example charcoal; firewood; wood sticks and others. Until 2000, there was no significant difference between forest extraction in 1970 (about 24.59%) and 2000 (about 22.58%), but there was a significantly different compared to 2017 (9.24%). It was predicted that forest extraction for fuel materials was not significantly different in 2050 (7.23%). The extraction of forests tended to decline continually from year to year due to the reducing forest area and biodiversity (Table 2).

Table 2. Non-timber extraction changes over time of swamp forests

Year	Volume harvested (%)						
	A	B	C	D	E	F	G
1970	24.59 ^a	17.24 ^a	15.35 ^a	9.11 ^a	9.31 ^a	9.01 ^a	15.39 ^a
2000	22.58 ^a	16.76 ^a	12.31 ^b	9.43 ^a	9.88 ^a	9.11 ^a	19.93 ^a
2017	9.24 ^b	11.92 ^b	10.41 ^c	10.67 ^a	9.76 ^a	8.69 ^a	39.31 ^b
2050*	7.23 ^b	5.04 ^c	4.57 ^d	4.73 ^b	9.88 ^a	9.11 ^a	59.44 ^c

Note: A (Fuel materials); B (Food sources, animal products); C (Food sources and spices, plant products); D (Medicine and pharmacy); E (Materials for handicrafts); F (Structure and fiber); and H (Others including agriculture, plantation, HTI stand for Industrial Plantation Forest etc.).

*/ Data were estimated based on landuse changes from imagery images. The year of 2050 is used for estimating because it is used by the Government (Departemen Kehutanan, 2007) as the year of the existence prediction of natural resources.

Source: Direct interview results with the respondents (2017).

Until 2000, rural communities took firewood in particular from vegetation type that has been dried and done regularly around the forest area. Almost all types of firewood were derived from stems and small twigs and easily moved by human hands. Big wood species were not taken because they are too heavy and require a lot of time to move the wood. Activity to take firewood was not done at all times (not intensely, just once a week), besides that in garden area provided also available firewood, for example *mahoni* branch, *dadap*, shade tree, bamboo and others. This way did not put pressure on the forest and it is preserved sustainably.

After 2000, there has been changed globally because some swamp forests was fully cleared by private large company of large plantations and HTI where land clearing was done heavy machine and fire, so most of the forest area was converted to oil palm or HTI.

3.3 Extraction of Forest Resources for Food Sources

In general, the non-timber extraction of swamp forests for food sources can be divided into two groups, i.e. food sources originated from wild animals and food sources originated from plant products. For food sources

derived from wild animals, the rural community around the forest area has hunted wild animals or cached fish in rivers, lakes or public waters.

Until 2000, various types of animals were often hunted for having meat such as birds, wild chickens (*Gallus gallus*), *alap-alap* (*Accipitridae sp.*), weasel (*Cynogale bennetti*), wild deer, honey, swallow nest and other types of animals. Although not consumed by the local population, the bird's nest is one of the most valuable commodities to sell. The skin, bones and teeth of animals can be made into handicrafts such as bags and necklaces. Wild animals also hunted for being pests for agricultural crops are wild pigs (*Sus barbatus*), ferrets, mouse, snakes, and others.

Various types of fishes are caught, namely *gabus* fish (*Channa Striata*), *baung* (*Mystus nemurus*), *patin* (*Pangasius sp.*), *palung* (*Hampala macrolepidota*), *tawes* (*Barbodes gonionotus*), *toman* (*Channa micropeltes*), *keting* (*Mytus nigriceps*), *kepras* (*Puntius binotatus*), *derbang* (*Puntius pinnauratus*), *lampan* (*Barbodes schwanenfeldi*), *seluang* (*Osteochillus schlegeli*), *lele* (*Clarias gariepinus*), *belut* (*Monopterus albus*) and other types of aquatic animals. The results of hunting and fishing were generally used to fulfill their own needs of animal protein.

Food sources derived from plant products can produce carbohydrates derived from tubers, such as *gadung* (*Dioscorea hispida*), *keladi* (*Caladium sp.*), *talas Padang* (*Colocasia gigantea*), *ubi pasir* (*Dioscorea pentaphylla*), *uwi* (*Dioscorea alata*) and wild banana (*Musa sp.*) and other species that grow wild. The benefits of forest as a source of vitamins are obtained by taking vegetables from forests such as mushroom (*Auricularia auricular*), nail vegetables (*Neprolepis bisserata*, *Sternoclaena palustris* and *Diplazium esculentum*), oyster mushroom (*Pleurotus ostreatus*) and others.

Forest products are often used to meet their own needs. Fresh fruits are obtained from forest area including coconut (*Cocos nucifera*), mango (*Mangifera indica*), jackfruit (*Artocarpus integrum*), *kesambi* (*Scheilera olease*) and various other fruits contained in the forest. Periodically, the rural community also takes the ingredients for cooking in the forest such as *daun salam* (*Eugenia sp.*), ginger (*Zingiber sp.*), *serai/sere* (*Cymbopogon citratus*), *kemiri* fruit (*Aleurites moluccana*) and other types.

The data analyses showed that there has been a decline in the volume of forest products harvested for food source by year. The volume of material harvested in 1970 (17.24%) was not significantly different from the volume of material harvested in 2000 (16.76%) and showed significantly different with the extraction of forests harvested in 2017 (11.92%) and significantly different from the forest extraction of 2050 (5.04 %). The same extraction of forest resources for food sources was derived from plant products. This decrease in forest extraction volume was mainly due to the decreasing forest area, so that the biodiversity living in the area is also decreasing, thus affecting the amount of non-timber extraction. Sarno et al (2017) identified the similarities of natural phenomena found in the mangrove forests in South Sumatra.

Some rural communities doing fishing in that are not sustainable ways, such as fishing with poison and electricity. Both ways caused the fishery stock to be destroyed and fishery resources are not able to be regenerated. According to rural community, after forest areas are easily accessible, and then fish catching by poisoning was mostly done by newcomers. It means after 2000 that large companies undertook land clearing for oil palm plantations and HTI. In fact rural communities are already aware that these methods of catching fish will threaten their life, but they do not have the ability to ban such illegal acts or they cannot remind them to avoid fishing by poisoning and electrocution. The reminding of the rural communities was positively responded by newcomers; even such it may trigger clashes among rural communities with newcomers from outside the village.

3.4 Extraction of Forest Resources for Medicines

Rural communities still have traditionally dependence on forests as a source of medicines because they are more likely to take traditional medicines than to seek treatment at a health center or to take medical medicines unless the disease is very serious, then the patient is taken to the health center. For medicinal products it is quite a bit difficult to identify products that are really only for medicine, since some products are usually used for daily use as well as for medicine, such as spices, resins, nests of swallow birds, and so on. The diversity of plant species taken from forests for medicine is presented in Table 3.

Various types of medicinal plants are mixed for various uses such as bathing, drinking, spraying or to compress in case of fractures. There are materials that can be used directly and some are dried first and then stored. Materials derived from leather and wood roots, usually stored because it is not easily damaged, but for the foliage is usually directly used, i.e. by boiling to be drunk or used for bathing.

Table 3. Diversity of plant species taken from forests used for medicine

Type of vegetation	Utility for rural community
<i>Jambu biji (Psidium guajava)</i>	Treat diarrhea
<i>Jarak (Jatropha curcas)</i>	Childbirth and treat dizziness
<i>Pulai (Alstonia scholaris)</i>	Malaria, paralysis and rheumatism
<i>Kunjur (Cassia fistula L)</i>	Headache, back pain, childbirth and clean dirty blood
<i>Kunyit (Curcuma domestica)</i>	Wash blood, clean dirty blood
<i>Kelor (Moringa oleifera)</i>	Decrease the placenta, increase milk production and improve child health
<i>Kumis kucing (Orthosiphon stamineus)</i>	Asthma, shortness of breath and diabetes
<i>Waru (Hibiscus tiliacus)</i>	Pain ear, treat cuts and prevent infection
<i>Sirih hutan (Piper amboinensis)</i>	Fractures, catalyst for spray medicines
<i>Mengkudu (Morinda sp.)</i>	Diabetes, liver, heart, high blood pressure, asthma and indigestion

Source: Direct interview results with the respondents (2017).

The results of the data analyses showed that there is no decrease in the volume of forest products harvested for medicine materials by year. Until 2017, there was no significant difference between forest extraction in 1970 (around 9.11%) and 2000 (about 9.43%) until 2017 (around 10.67%). It was predicted forest extraction for medicine materials was significantly different in 2050 (4.73%). This is due to the decreasing biodiversity of the forests and the extent of the area was also declining sharply. In addition to rural communities increasingly aware and believe in medical treatment, so if they are sick, then they will visit the nearest health center.

3.5 Extraction of Forest Resources for Handicraft Materials

Various forms of handicrafts can be made by rural communities whose basic materials are extracted from forest products. Wild plants are usually used as fiber, such as *purun* and *pandan* to make mats, baskets, rice bowl or rice container, hats and others. Rural communities often use banana leaves to wrap food, *nipah* leaves and betel nuts for the house roof especially for houses in the garden, and *pandan* leaves for handicrafts. Handicrafts made from *purun* and *pandan* leaves are mats, either small size (1x2 m) for food mat or table cloth or large size commonly used for bedding. *Purun* and *pandan* leaves are also used to make a hat as a protective head while in the garden or rice fields. The leaves are very little found around the yard or in the garden.

In addition to the daily life of rural communities, they need rigging as a binder obtained from bark, rattan, and palm fiber from several palm trees. In everyday life communities need ropes to tie livestock, binding goods or building custom homes. Most rope materials are taken by rural communities from forest areas. The public distinguishes the rope type that is used for instant use with strap types for long-term use. The rope type for instant use was directly used by residents to bind goods or other objects for short term interests. As for the type of rope for long-term use, usually the rope obtained is processed first to become stronger and tidier by spinning, and then it was used to bind cattle or building construction equipment.

The results of the data analyses showed that there is no decrease in the volume of forest products harvested for handicraft materials by year. It is not significantly different between forest extractions from 1970 to 2017. It was predicted that forest extraction for handicraft materials was also not significantly different in 2050. This is because rural communities are less interested in handicraft anymore because considering the handicraft work is less desirable by market and society difficult to sell handicraft products, so the result of making handicraft only to meet the needs of their own household.

3.6 Extraction of Forest Resources for Structure

Rattan and bamboo were collected periodically to meet the needs of building materials, making household appliances such as *nyiru*, baskets, bamboo chairs, livestock pens, and for other uses. Rattan is a kind of vines with the shape of a round stem with a length of about 10-60 m. Due to its strong, long, flexible and durable properties make rattan a versatile raw material. Whole rattan is usually used as furniture, household appliances and other accessories. Medium rattan skin can be used as handicraft products such as baskets, bags, mats, etc.

There are many types of bamboo. Although the nature of bamboo is not like rattan, but many bamboo is also used to make furniture, handicraft items, homes in villages, bridges, household appliances, and others. Bamboo is used to make house walls (*gedek*), yard fence, traditional house construction and cot (bed). They also use bamboo to make fish traps in rivers, stem the water, drain water and make simple bridges. The community also developed bamboo plants around the yard, settlements and farming as well as plantation area, so it does not depend on the existing bamboo resources in the forest.

The results of the data analyses show that there is no change in the volume of forest products harvested for structural and fibers materials by year. There is no significant difference between forest extraction from 1970 to 2017 and predicted forest extraction for handicraft materials is also not significantly different in 2050. This is because rural communities are less interested in extracting structural and fiber materials from forest areas due to forest areas has provided less such materials, in addition to that there are many other materials that can be used as a subsistence of material derived from forest areas. In addition, the general public is less interested in materials that come directly from forest areas, urban communities prefer subsistence materials, so that the extraction of structures and fiber coming from forest areas is only to meet the needs of their own household.

3.7 Extraction of Forest Resources for Other Uses

Extraction of forest resources for other uses was mostly harvested other than those categorized above, for example yields of agro forestry, plantation, ornamental plants, chemical materials and other activities. Ornamental plants are usually used for home decoration; flowers are also used for perfume raw materials, also for dye (for dyeing cloth). Some flowers have high values, namely various types of orchids, which are admired for its beauty and various types of fern plants. But many species of orchids are already threatened with extinction, including black orchid. Orchid plants can usually be cultivated in the yard or orchid garden. To produce chemical materials, there are several ways, namely by tapping directly from the tree and then taken out fluid (usually a sap). Another way is to distill or mix with the solvent, especially resin, camphor, and others.

The results of the data analyses showed that there have been many changes in the volume of forest products harvested by year. It was significantly different between forest extraction in 1970 (about 15.39%) compared to 2000 (about 19.93%) and significantly different from 2017 (39.31%). It was predicted that forest extraction for other uses was also significantly different in the year 2050 (59.44%). The rural communities are less interested in taking other products from forested areas because the forest area has less supply of these materials, besides that there are many other materials can be used as a subsistence of material derived from forest areas. In addition, they are already dependent on palm oil plantations that are more promising for their future life. This is in line with Barati et al (2017) finding that the role of human capital factor is very important in poverty alleviating.

3.8 Conservation and Revitalization of Forest and Land Resources

In management of forest and land resources, two approaches are commonly known, namely the vegetation approach and the civil technical approach. A mixed swamp forest and lands agriculture is mentioned as the vegetation approach in land rehabilitation. The use of vegetation methods has several advantages, namely: to protect the soil structure from kinetic energy of falling rain granules; to protect the soil from surface runoff strength; and to increase the capacity of soil infiltration and the ability to retain groundwater, so that the amount of groundwater absorbed into the soil is increased more and more. Further emphasized several ways included in this approach are divided into several ways, i.e. reforestation; planting by contour; crop rotation; maintaining grass or leguminous plants; covering the ground surface with mulch and agro forestry practices. The similar approach was stated by Armanto et al (2016) and Wildayana et al (2017).

3.8.1 No Burning for Land Clearing

There is no proper solution to clear the land other than by burning because land clearance by burning is considered the easiest, most efficient and efficient way. To reduce the negative impacts of land burning, the burning of the land is done with due regard to local wisdom and is always closely watched, so the smoke that arises from the burning of land does not cause problems for other community activities. Before burning, farmers usually dig a hole bordering area of land to be burned and the area of burned land is also relatively small, where the most extensive one hectare only. When carrying out the burning of land is always maintained, so the fire does not spread to other communities' land. If the fire spread to another person's land, the one who burns will be subject to sanction or customary law. Meanwhile, the cost to pay for sanctions or customary law is enormous, and very difficult to meet by rural communities.

The rest of the combustion will be used as fertilizer for the plants. The land is burned and clean, and then it will be planted with various types of plants ranging from rice, fruit and vegetables. If the peatlands have been burned, of course it was very difficult to extinguish and cause a thick haze thick enough. In the event of a fire on peatlands and land owned by the company can cause smoke haze that disrupts the activities of the community. The land burned by rural communities does not cause smoke haze that can disturb the activities of the community.

3.8.2 Planting of Multi Purposes Tree Species (MPTS)

MPTS species are plants that have very diverse uses or are called multipurpose trees because they are capable of supplying food (e.g. fruits, nuts or vegetables); firewood; increasing soil fertility (e.g. nitrogen, soil organic matter); providing shade, habitat, part of living fence, windbreak and others. When multipurpose trees are planted, a number of needs and functions can be fulfilled at once. Some versatile trees, among others: *Moringa oleifera* plant, where the morphological parts of plants, such as leaves, pods and nuts that can be used as animal feed, medicines and shade functions. The deep coconut (coconut palm) can be used as foodstuff, drinking water, house roof, firewood, broom stick, and shade. Ideally most of the trees found on tropical farms should be multipurpose trees, and provide more benefits to farmers. In general, the versatile tree includes the leguminous household that is able to supply nitrogen into the soil and to increase food security. It is also suggested by Armanto et al (2013) and Fobissie et al (2017).

Rural communities increase the diversity of plant species that have a protected function such as *beringin* tree (*Ficus benjamina*), acacia (*Acacia sp.*), *mahoni* (*Swietenia macrophylla*), *dadap* (*Eritryna sp.*), *gmelina* (*Gmelina arborea*), bamboo (*Bambusa sp.*) and some MPTS. Rural community also considers to fulfill the needs of livestock feed by developing the types of plants that can be used as animal feed, i.e. *turi* (*Sesbania grandiflora*), *lamtoro or petai cina* (*Leucaena leucocephala*), *kaliandra putih* (*Zapateca tetragona*), wild pisang (*Musa parasidica*), *gamal* (*Gliricidia sepium*), *kaliandra merah* (*Calliandra calothyrsus*), king grass and tubers. The element of soil and water conservation is done not only on certain aspects, but rather it can provide space for the development of other sectors such as farms.

3.8.3 Harvesting Non-timber Products

Some parents teach their children about restrictions on the misuse of forests such as taking wood, destroying saplings and releasing livestock into the forest. With livelihoods in the agricultural sector, the ability to connect forest conservation with water systems can be mentioned as a measure of the existence of ecological wisdom. Yosada et al (2017) suggested the same for sustainability of natural resources.

With regard to soil and water conservation through social forestry approaches, local knowledge about the ways of farming and interacting with forests, soil and water needs to be re appreciated through various tools and regulation of social forestry development by taking into account:

- 1) Policies should be directed with the aim of revitalizing local utilization practices or initiatives in support of forest, land and water management.
- 2) Forest resource management practices should be objectively accommodated by local communities as a foundation for the implementation of forestry sector development in rural areas.
- 3) Rural communities should be the main actors of forest, land and water management processes and can ascertain the direction and objectives of the process.

In order to improve the appreciation and internalization of various agricultural practices of swamp forests by local communities for generations, some considerations are needed to be conditioned as follows:

- 1) The development of crop species should prioritize local crop species that have adapted to various patterns of community utilization along with social, economic, ecological, and rural cultural functions.
- 2) Forest, land and water management approach should recognize and represent approaches on tribes, household, farmer group and others.
- 3) Small scale forest units can be managed collectively by local groups while still providing roles and contributions to each household to contribute to individual management, as well as to be inherited based on customs and inheritance system which applies in rural communities.
- 4) Need revitalization and re-actualization of mixed based swamp forest and lands agriculture including reconstruction of customary rules that support sustainable forest, land and water management.

The successful key in various forest reforestation activities is very clear to the community as the subject of the perpetrator. Without a strong desire and a thorough understanding in the community about the importance of forest sustainability will lead to various reforestation efforts to be hampered, resulting in no results. Therefore, in addition to the review of the technical aspects such as the land and water conservation and rehabilitation aspects described above, it should also be discussed further on the conservation aspect of the culture itself. Socialization will certainly be faced with constraints such as modernization and technological progress and population growth. Therefore, possible steps to be taken include:

- 1) Schools can be utilized as a mediating tool and channel socialization formally optimized its function.
- 2) Government intervention and stakeholders have to invite the mass media, especially television and radio to become a channel of socialization.
- 3) A reward program for communities can be maintained as sustainability at the household level through indicators of community forest development.
- 4) A model village or pilot village in one community around the forest area should be created to stick to local initiatives.

4. Conclusions

Before 2000, rural community initiatives in swamp forests are known to have demonstrated strong interaction between rural communities, forest resources and the customary regulations still firmly held by the rural community. Various types of products extracted by priority are fuel material, food sources, medicine and pharmacy, materials for handicrafts, structures and other uses. After 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, leaves, thatching grass, resins, dyes, manure and others. These activities have caused degradation of swamp forest. To minimize the impact of swamp forest degradation, the active participation involvement of the rural community and all other stakeholder components is essential to optimize swamp forest management. The revitalization of rural initiatives is a strategic opportunity that can be utilized optimally in support of swamp forest managements. These efforts can be achieved through the identification of the potential to obtain a complete data base on rural initiatives available to support swamp forest managements. Other efforts can be pursued through policy approaches, namely by providing space for the re-functioning of existing rural initiatives through the integration of rural traditional codes into formal legal codes of environmental regulations.

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10. Final Paper Online Published di Journal of Sustainable Development (JSD). Vol. 11(2); 52- 62, 30 Maret 2018**Utilizing Non-Timber Extraction of Swamp Forests over Time for Rural Livelihoods**Elisa Wildayana¹ & M. Edi Armanto¹¹ Faculty of Agriculture, Universitas Sriwijaya, Indralaya Campus, South Sumatra, Indonesia

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URL: <https://doi.org/10.5539/jsd.v11n2p52>**Abstract**

The research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods. This research was carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra, Indonesia. The data were collected by direct field observation, intensive study of archive report documents as well as in-depth interviews with the respondents. Before 2000, rural communities could be mentioned to be relatively concerned about the status of forest and land resources because they have utilized forest and land resources following customary regulations. Various types of products extracted by their priority are fuel material, food sources, medicine and pharmacy, raw materials for handicrafts, structures and other uses. After 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, thatching grass, woven mats (from *purun*), rope webbing, leaves, resins, dyes, manure and others. These activities have caused degradation of swamp forest. To minimize the impact of swamp forest degradation, the active participation involvement of the rural community and all other stakeholder components is essential to optimize swamp forest management.

Keywords: utilizing, non-timber extraction, swamp forests, rural livelihoods**1. Introduction**

Increasing population growth is mentioned as an unavoidable fact especially in developing countries and has an impact on increasing human needs for clothing, food and housing (Armanto et al., 2017a). Thus it is increasing pressure on forest and land resources, so that without realizing the swamp forest and lands are seriously threatened their existence due to degradation through programmed government policy and private sectors as well as rural community (Armanto et al., 2013).

Non-timber forest products come from tree parts or plants and include all biological diversity except timber, which are extracted from forests having special properties for human uses. These forest products include food, medicines, spices, resins, rubber, ornamental plants, animals and products produced by animals (e.g. fishes, swallow nests, honey, etc.), rattan, bamboo and fibers e.g. *purun* (*Eleocharis dulcis*) and *pandan* (*Pandanus sp*) for making woven mats. They can be needed by the forest community (communities living around the forest), sold for an industry or for its own needs. Its collection does not require complicated licensing as in timber harvesting and forest communities are generally free to collect and to utilize non-timber forest products. They are not prohibited to collect and utilize them, except within protected forests and nature conservation areas. Non-timber forest products are utilized as rural livelihoods for millions of forest communities. They utilize non-timber forest products for their directly consumptive needs, such as wild animals, tubers, fruits, vegetables, medicines, firewood and others, or for making money such as rattan, resin, honey, and others. All non-timber forest products have the same characteristics that are excavated by communities in and around forests using simple technology (Mugisha et al., 2017; Armanto et al., 2016).

Before 2000, farmers in swamp forests have developed agriculture around the forest according to local initiatives, while agriculture alternative was very limited. Rural community was aware that their life was strongly determined on available forest and land resources, so that they have appreciated any component of the existing natural resources and also realized that degradation of forest and land resources will lead to drought (Wildayana, 2017). Drought will cause their agricultural productivity to decline sharply because water is needed in each stage of the farming process. In addition, the rapid rate of land degradation is determined as an accumulation of

population growth that causes increased pressures on lands, less successful reforestation and lack of support for land and water rehabilitation technologies (Firmansyah et al., 2016; Udoh et al., 2017).

Generally rural community in South Sumatra had local initiatives in interacting with forests, land and water. However, the local initiatives have received fewer acceptances from the government and less recognized by territorial rights (Wildayana et al., 2016a). Thus the local initiatives should be developed with respect to commodity zoning; competition and market demand on the other hand the challenge to swamp forest and lands is very high. Local initiatives controlled by customary rights were effective in controlling forest and land degradation because these local initiatives had been able to establish interactions between rural communities with forest and land resources and was still firmly held by rural communities.

After 2000, land use changes in the swamp forest were initiated by the government by granting consent permits for the use of forests and swamp forest area for oil palm plantations, and then large lands were cleared and opened regardless of preservation because the land clearing was done by burning. The fire will change the thorough ecosystem not only in the bio geophysical aspect, but also in the social and cultural aspects of society. Because the area is already opened and access to forests becomes easier, rural communities become triggered to participate in excessive forest extraction in order to benefit as large companies do. This implies the land in danger of being not only from large companies, but also by local government (Wildayana et al., 2016b). They have done land clearing without regarding to environmental aspects. The rural communities also have been triggered to extract forests to gain a share of the benefits without regard to environmental aspects also, such as fishing with electric and toxic strum, so that almost all aquatic biota become threatened by its existence or open forests to farm in areas that are easily accessible by fire. This causes land cover to decrease and lead to degradation of land and water resources.

The direct impact is felt by rural communities because the forest and land has been degraded and water catchment function is decreased which decrease of agricultural land productivity. The difficulty of clean water is a major factor that encourages the awakening of public awareness of the importance of the region (Tavakoli et al., 2017; Pangerungan et al., 2017). That is, well-preserved forests will bridge the ongoing rains that can support all life components of communities. The downfall will enable the community to diversify the crops and farming patterns on managed lands, increasing productivity and income. Based on the above problems, the research aimed to analyze utilizing non-timber extraction of swamp forests over time for rural livelihoods.

2. Materials and Methods

This research has been carried out in swamp forests of Ogan Komering Ilir (OKI) District, South Sumatra. Demarcation of OKI District, South Sumatra Province, Indonesia is given in Figure 1. The data were collected by direct field observation, intensive study of archive report documents as well as in-depth interviews with the respondents. The process of collecting data was made through participatory approach where researchers took place in daily life of farmers. Techniques of collecting data were using questionnaires and the number of respondents was 377 households of farmers. In-depth interviews to key informants were carried out with key informants, mostly from community leaders consisting of sub-district heads, village heads, neighborhood heads, village leaders as well as the chairmen of NGO (Non-Governmental Organizations). The intensive study of archive report documents came from Government and private institutions, such as the Regional Development Planning Board or NGO as well as University. Collected data were concluded, presented and then analyzed statistically. The research scope is focused on the aspects, such as the experiences of rural communities living around the area, the utilization of forest resources by rural communities, the rehabilitation and conservation of lands, and the revitalization of forest and land resources.



Figure 1. Demarcation of OKI District, South Sumatra Province, Indonesia
(Source: Google website)

3. Results and Discussion

This research has discussed the condition of rural communities around the forest; extraction of forest resources for fuel materials; food sources; medicine; handicraft; structure and fiber; and revitalization and cultural conservation.

3.1 Condition of Rural Communities around the Forest before 2000

Before 2000, the life of rural communities around the forest could be said to be in harmony with nature. The existence of community initiatives to pay attention to all ecological components was related to forest functions as an important resource for their life. To manage utilization of forest, land and water resources, local communities have built customary agreements to prohibit communities to clearing forest by burning. This agreement governs the rights and obligations of each individual, including those violating the customary sanctions. Awareness of the community has been built and the local rules allowed efforts to conserve the forest area in a sustainable manner. This study is in line with the findings of Adriani & Wildayana (2015) who saw how the economic growth in the agricultural sector.

The farming pattern was developed by rural communities around the swamp forest area to carry out sustainable utilization of forest, land and water resources. This customary arrangement encourages communities to be the most important part of any effort to conserve forest and land resources. The rural community were still inherits socio-cultural values in environmental management, where the life concept of triangle harmonized the balance of life between humans, the universe and God Almighty. Life balance between these three components becomes the central point of all the behavior of rural community in their daily life. The similar result was also demonstrated by Armanto & Wildayana (2016).

Villages located around the forest could be determined as buffering zones and they have utilized forests as an income source of households. Some non-timber forest products are often utilized namely *purun*, honey, fish and fruits. Armanto et al (2017b) also analyzed various swamp functions to support the livelihood sources of local farmers and surrounding communities.

To increase the socio-economic benefits, some inputs of forest management should be provided through the development of social forestry models by empowering rural communities. Reinforcement of swamp agroforestry and mixed agriculture could be done through agricultural commodities, forestry, plantation and livestock farming, so that management approach could be done thoroughly by accommodating various stakeholders, including community, government and customary leaders. Limba et al (2017) stated how local wisdom principles can be applied in agricultural activities and as a source of local livelihoods. Direct use of swamp forests for rural livelihoods is presented in Table 1.

Table 1. Direct uses of swamp forests for rural livelihoods

Forest products	Harvested material from forest area	Priority
Fuel materials	Firewood; charcoal; wood sticks	1
Food sources (animal products)	Bush meat; fishes; shrimps; honey; wild animals; wild birds	2
Food sources and spices (plant products)	Wild fruits; vegetables; foliage leaves for fresh vegetables; mushroom; nuts	3
Materials for handicrafts	Thatching grass (<i>atap daun</i>); woven mats (<i>tikar purun</i>); baskets; brooms; vines; dyes; rope webbing; dyes; and others	4
Structure and fiber	Construction materials; poles; sawn wood; bamboos; timber	5
Medicine and pharmacy	Drugs (medicines); utilitarian; ritual materials	6
Other Uses	Agroforestry; plantations; agriculture; fodder; leaves; resins; manure and others	7

Source: Direct interview results with the respondents (2017).

Income of household from forests was obtained by forest extraction, such as honey, fruits, ropes, game animals, medicines and others. Rural communities often utilized the materials for their own use as well as for the common

good in their social communities. The income from forests was not always assessed by the amount of money how much they earned because they did not always sell, but they used for the benefit of their household and communities. Lu (2017) explained there is a relationship between land and forest with human survival.

The life of rural communities around the forest after 2000 could be said to change completely. Their dependence on forest extraction results was diminishing and they were dependent on oil palm plantations and industrial plantation forest (HTI), which planting acacia trees (*Acacia crassicarpa*). They work on large plantations and HTI as harvesters, gardeners and day laborers. Fishing has been done very little since rivers and public waters no longer provide fish, most of the fishery resources have been destroyed because of fishing practices that do not conserve the environment (using poison and electric shocks). A similar study was reported by Dzidza et al (2017) that it found similar natural phenomena occurring in Ghana.

3.2 Extraction of Forest Resources for Fuel Materials

Fuel materials are originated from organic materials from forest resources to generate energy, for example charcoal; firewood; wood sticks and others. Until 2000, there was no significant difference between forest extraction in 1970 (about 24.59%) and 2000 (about 22.58%), but there was a significantly different compared to 2017 (9.24%). It was predicted that forest extraction for fuel materials was not significantly different in 2050 (7.23%). The extraction of forests tended to decline continually from year to year due to the reducing forest area and biodiversity (Table 2).

Table 2. Non-timber extraction changes over time of swamp forests

Year	Volume harvested (%)						
	A	B	C	D	E	F	G
1970	24.59 ^a	17.24 ^a	15.35 ^a	9.11 ^a	9.31 ^a	9.01 ^a	15.39 ^a
2000	22.58 ^a	16.76 ^a	12.31 ^b	9.43 ^a	9.88 ^a	9.11 ^a	19.93 ^a
2017	9.24 ^b	11.92 ^b	10.41 ^c	10.67 ^a	9.76 ^a	8.69 ^a	39.31 ^b
2050*	7.23 ^b	5.04 ^c	4.57 ^d	4.73 ^b	9.88 ^a	9.11 ^a	59.44 ^c

Note: A (Fuel materials); B (Food sources, animal products); C (Food sources and spices, plant products); D (Medicine and pharmacy); E (Materials for handicrafts); F (Structure and fiber); and H (Others including agriculture, plantation, HTI stand for Industrial Plantation Forest etc.).

* / Data were estimated based on landuse changes from imagery images. The year of 2050 is used for estimating because it is used by the Government (Departemen Kehutanan, 2007) as the year of the existence prediction of natural resources.

Source: Direct interview results with the respondents (2017).

Until 2000, rural communities took firewood in particular from vegetation type that has been dried and done regularly around the forest area. Almost all types of firewood were derived from stems and small twigs and easily moved by human hands. Big wood species were not taken because they are too heavy and require a lot of time to move the wood. Activity to take firewood was not done at all times (not intensely, just once a week), besides that in garden area provided also available firewood, for example *mahoni* branch, *dadap*, shade tree, bamboo and others. This way did not put pressure on the forest and it is preserved sustainably.

After 2000, there has been changed globally because some swamp forests was fully cleared by private large company of large plantations and HTI where land clearing was done heavy machine and fire, so most of the forest area was converted to oil palm or HTI.

3.3 Extraction of Forest Resources for Food Sources

In general, the non-timber extraction of swamp forests for food sources can be divided into two groups, i.e. food sources originated from wild animals and food sources originated from plant products. For food sources derived from wild animals, the rural community around the forest area has hunted wild animals or cached fish in rivers, lakes or public waters.

Until 2000, various types of animals were often hunted for having meat such as birds, wild chickens (*Gallus gallus*), *alap-alap* (*Accipitridae sp.*), weasel (*Cynogale bennetti*), wild deer, honey, swallow nest and other types of animals. Although not consumed by the local population, the bird's nest is one of the most valuable

commodities to sell. The skin, bones and teeth of animals can be made into handicrafts such as bags and necklaces. Wild animals also hunted for being pests for agricultural crops are wild pigs (*Sus barbatus*), ferrets, mouse, snakes, and others.

Various types of fishes are caught, namely *gabus* fish (*Channa Striata*), *baung* (*Mystus nemurus*), *patin* (*Pangasius sp*), *palung* (*Hampala macrolepidota*), *tawes* (*Barbodes gonionotus*), *toman* (*Channa micropeltes*), *keting* (*Mytus nigriceps*), *kepras* (*Puntius binotatus*), *derbang* (*Puntius pinnauratus*), *lampan* (*Barbodes schwanenfeldi*), *seluang* (*Osteochillus schlegeli*), *lele* (*Clarias gariepinus*), *belut* (*Monopterus albus*) and other types of aquatic animals. The results of hunting and fishing were generally used to fulfill their own needs of animal protein.

Food sources derived from plant products can produce carbohydrates derived from tubers, such as *gadung* (*Dioscorea hispida*), *keladi* (*Caladium sp.*), *talas Padang* (*Colocasia gigantea*), *ubi pasir* (*Dioscorea pentaphylla*), *uwi* (*Dioscorea alata*) and wild banana (*Musa sp.*) and other species that grow wild. The benefits of forest as a source of vitamins are obtained by taking vegetables from forests such as mushroom (*Auricularia auricular*), nail vegetables (*Neprolepis bisserata*, *Sternoclaena palustris* and *Diplazium esculentum*), oyster mushroom (*Pleurotus ostreatus*) and others.

Forest products are often used to meet their own needs. Fresh fruits are obtained from forest area including coconut (*Cocos nucifera*), mango (*Mangifera indica*), jackfruit (*Artocarpus integra*), *kesambi* (*Scheilera olease*) and various other fruits contained in the forest. Periodically, the rural community also takes the ingredients for cooking in the forest such as *daun salam* (*Eugenia sp.*), ginger (*Zingiber sp.*), *serai/sere* (*Cymbopogon citratus*), *kemiri* fruit (*Aleurites moluccana*) and other types.

The data analyses showed that there has been a decline in the volume of forest products harvested for food source by year. The volume of material harvested in 1970 (17.24%) was not significantly different from the volume of material harvested in 2000 (16.76%) and showed significantly different with the extraction of forests harvested in 2017 (11.92%) and significantly different from the forest extraction of 2050 (5.04 %). The same extraction of forest resources for food sources was derived from plant products. This decrease in forest extraction volume was mainly due to the decreasing forest area, so that the biodiversity living in the area is also decreasing, thus affecting the amount of non-timber extraction. Sarno et al (2017) identified the similarities of natural phenomena found in the mangrove forests in South Sumatra.

Some rural communities doing fishing in that are not sustainable ways, such as fishing with poison and electricity. Both ways caused the fishery stock to be destroyed and fishery resources are not able to be regenerated. According to rural community, after forest areas are easily accessible, and then fish catching by poisoning was mostly done by newcomers. It means after 2000 that large companies undertook land clearing for oil palm plantations and HTI. In fact rural communities are already aware that these methods of catching fish will threaten their life, but they do not have the ability to ban such illegal acts or they cannot remind them to avoid fishing by poisoning and electrocution. The reminding of the rural communities was positively responded by newcomers; even such it may trigger clashes among rural communities with newcomers from outside the village.

3.4 Extraction of Forest Resources for Medicines

Rural communities still have traditionally dependence on forests as a source of medicines because they are more likely to take traditional medicines than to seek treatment at a health center or to take medical medicines unless the disease is very serious, then the patient is taken to the health center. For medicinal products it is quite a bit difficult to identify products that are really only for medicine, since some products are usually used for daily use as well as for medicine, such as spices, resins, nests of swallow birds, and so on. The diversity of plant species taken from forests for medicine is presented in Table 3.

Table 3. Diversity of plant species taken from forests used for medicine

Type of vegetation	Utility for rural community
<i>Jambu biji (Psidium guajava)</i>	Treat diarrhea
<i>Jarak (Jatropha curcas)</i>	Childbirth and treat dizziness
<i>Pulai (Alstonia scholaris)</i>	Malaria, paralysis and rheumatism
<i>Kunjur (Cassia fistula L)</i>	Headache, back pain, childbirth and clean dirty blood
<i>Kunyit (Curcuma domestica)</i>	Wash blood, clean dirty blood
<i>Kelor (Moringa oleifera)</i>	Decrease the placenta, increase milk production and improve child health
<i>Kumis kucing (Orthosiphon stamineus)</i>	Asthma, shortness of breath and diabetes
<i>Waru (Hibiscus tiliacus)</i>	Pain ear, treat cuts and prevent infection
<i>Sirih hutan (Piper amboinensis)</i>	Fractures, catalyst for spray medicines
<i>Mengkudu (Morinda sp.)</i>	Diabetes, liver, heart, high blood pressure, asthma and indigestion

Source: Direct interview results with the respondents (2017).

Various types of medicinal plants are mixed for various uses such as bathing, drinking, spraying or to compress in case of fractures. There are materials that can be used directly and some are dried first and then stored. Materials derived from leather and wood roots, usually stored because it is not easily damaged, but for the foliage is usually directly used, i.e. by boiling to be drunk or used for bathing.

The results of the data analyses showed that there is no decrease in the volume of forest products harvested for medicine materials by year. Until 2017, there was no significant difference between forest extraction in 1970 (around 9.11%) and 2000 (about 9.43%) until 2017 (around 10.67%). It was predicted forest extraction for medicine materials was significantly different in 2050 (4.73%). This is due to the decreasing biodiversity of the forests and the extent of the area was also declining sharply. In addition to rural communities increasingly aware and believe in medical treatment, so if they are sick, then they will visit the nearest health center.

3.5 Extraction of Forest Resources for Handicraft Materials

Various forms of handicrafts can be made by rural communities whose basic materials are extracted from forest products. Wild plants are usually used as fiber, such as *purun* and *pandan* to make mats, baskets, rice bowl or rice container, hats and others. Rural communities often use banana leaves to wrap food, *nipah* leaves and betel nuts for the house roof especially for houses in the garden, and *pandan* leaves for handicrafts. Handicrafts made from *purun* and *pandan* leaves are mats, either small size (1x2 m) for food mat or table cloth or large size commonly used for bedding. *Purun* and *pandan* leaves are also used to make a hat as a protective head while in the garden or rice fields. The leaves are very little found around the yard or in the garden.

In addition to the daily life of rural communities, they need rigging as a binder obtained from bark, rattan, and palm fiber from several palm trees. In everyday life communities need ropes to tie livestock, binding goods or building custom homes. Most rope materials are taken by rural communities from forest areas. The public distinguishes the rope type that is used for instant use with strap types for long-term use. The rope type for instant use was directly used by residents to bind goods or other objects for short term interests. As for the type of rope for long-term use, usually the rope obtained is processed first to become stronger and tidier by spinning, and then it was used to bind cattle or building construction equipment.

The results of the data analyses showed that there is no decrease in the volume of forest products harvested for handicraft materials by year. It is not significantly different between forest extractions from 1970 to 2017. It was predicted that forest extraction for handicraft materials was also not significantly different in 2050. This is because rural communities are less interested in handicraft anymore because considering the handicraft work is less desirable by market and society difficult to sell handicraft products, so the result of making handicraft only to meet the needs of their own household.

3.6 Extraction of Forest Resources for Structure

Rattan and bamboo were collected periodically to meet the needs of building materials, making household

appliances such as *nyiru*, baskets, bamboo chairs, livestock pens, and for other uses. Rattan is a kind of vines with the shape of a round stem with a length of about 10-60 m. Due to its strong, long, flexible and durable properties make rattan a versatile raw material. Whole rattan is usually used as furniture, household appliances and other accessories. Medium rattan skin can be used as handicraft products such as baskets, bags, mats, etc.

There are many types of bamboo. Although the nature of bamboo is not like rattan, but many bamboo is also used to make furniture, handicraft items, homes in villages, bridges, household appliances, and others. Bamboo is used to make house walls (*gedek*), yard fence, traditional house construction and cot (bed). They also use bamboo to make fish traps in rivers, stem the water, drain water and make simple bridges. The community also developed bamboo plants around the yard, settlements and farming as well as plantation area, so it does not depend on the existing bamboo resources in the forest.

The results of the data analyses show that there is no change in the volume of forest products harvested for structural and fibers materials by year. There is no significant difference between forest extraction from 1970 to 2017 and predicted forest extraction for handicraft materials is also not significantly different in 2050. This is because rural communities are less interested in extracting structural and fiber materials from forest areas due to forest areas has provided less such materials, in addition to that there are many other materials that can be used as a subsistence of material derived from forest areas. In addition, the general public is less interested in materials that come directly from forest areas, urban communities prefer subsistence materials, so that the extraction of structures and fiber coming from forest areas is only to meet the needs of their own household.

3.7 Extraction of Forest Resources for Other Uses

Extraction of forest resources for other uses was mostly harvested other than those categorized above, for example yields of agro forestry, plantation, ornamental plants, chemical materials and other activities. Ornamental plants are usually used for home decoration; flowers are also used for perfume raw materials, also for dye (for dyeing cloth). Some flowers have high values, namely various types of orchids, which are admired for its beauty and various types of fern plants. But many species of orchids are already threatened with extinction, including black orchid. Orchid plants can usually be cultivated in the yard or orchid garden. To produce chemical materials, there are several ways, namely by tapping directly from the tree and then taken out fluid (usually a sap). Another way is to distill or mix with the solvent, especially resin, camphor, and others.

The results of the data analyses showed that there have been many changes in the volume of forest products harvested by year. It was significantly different between forest extraction in 1970 (about 15.39%) compared to 2000 (about 19.93%) and significantly different from 2017 (39.31%). It was predicted that forest extraction for other uses was also significantly different in the year 2050 (59.44%). The rural communities are less interested in taking other products from forested areas because the forest area has less supply of these materials, besides that there are many other materials can be used as a subsistence of material derived from forest areas. In addition, they are already dependent on palm oil plantations that are more promising for their future life. This is in line with Barati et al (2017) finding that the role of human capital factor is very important in poverty alleviating.

3.8 Conservation and Revitalization of Forest and Land Resources

In management of forest and land resources, two approaches are commonly known, namely the vegetation approach and the civil technical approach. A mixed swamp forest and lands agriculture is mentioned as the vegetation approach in land rehabilitation. The use of vegetation methods has several advantages, namely: to protect the soil structure from kinetic energy of falling rain granules; to protect the soil from surface runoff strength; and to increase the capacity of soil infiltration and the ability to retain groundwater, so that the amount of groundwater absorbed into the soil is increased more and more. Further emphasized several ways included in this approach are divided into several ways, i.e. reforestation; planting by contour; crop rotation; maintaining grass or leguminous plants; covering the ground surface with mulch and agro forestry practices. The similar approach was stated by Armanto et al (2016) and Wildayana et al (2017).

3.8.1 No Burning for Land Clearing

There is no proper solution to clear the land other than by burning because land clearance by burning is considered the easiest, most efficient and efficient way. To reduce the negative impacts of land burning, the burning of the land is done with due regard to local wisdom and is always closely watched, so the smoke that arises from the burning of land does not cause problems for other community activities. Before burning, farmers usually dig a hole bordering area of land to be burned and the area of burned land is also relatively small, where the most extensive one hectare only. When carrying out the burning of land is always maintained, so the fire does not spread to other communities' land. If the fire spread to another person's land, the one who burns will be

subject to sanction or customary law. Meanwhile, the cost to pay for sanctions or customary law is enormous, and very difficult to meet by rural communities.

The rest of the combustion will be used as fertilizer for the plants. The land is burned and clean, and then it will be planted with various types of plants ranging from rice, fruit and vegetables. If the peatlands have been burned, of course it was very difficult to extinguish and cause a thick haze thick enough. In the event of a fire on peatlands and land owned by the company can cause smoke haze that disrupts the activities of the community. The land burned by rural communities does not cause smoke haze that can disturb the activities of the community.

3.8.2 Planting of Multi Purposes Tree Species (MPTS)

MPTS species are plants that have very diverse uses or are called multipurpose trees because they are capable of supplying food (e.g. fruits, nuts or vegetables); firewood; increasing soil fertility (e.g. nitrogen, soil organic matter); providing shade, habitat, part of living fence, windbreak and others. When multipurpose trees are planted, a number of needs and functions can be fulfilled at once. Some versatile trees, among others: *Moringa oleifera* plant, where the morphological parts of plants, such as leaves, pods and nuts that can be used as animal feed, medicines and shade functions. The deep coconut (coconut palm) can be used as foodstuff, drinking water, house roof, firewood, broom stick, and shade. Ideally most of the trees found on tropical farms should be multipurpose trees, and provide more benefits to farmers. In general, the versatile tree includes the leguminous household that is able to supply nitrogen into the soil and to increase food security. It is also suggested by Armanto et al (2013) and Fobissie et al (2017).

Rural communities increase the diversity of plant species that have a protected function such as *beringin* tree (*Ficus benjamina*), acacia (*Acacia sp.*), *mahoni* (*Swietenia macrophylla*), *dadap* (*Eritryna sp.*), *gmelina* (*Gmelina arborea*), bamboo (*Bambusa sp.*) and some MPTS. Rural community also considers to fulfill the needs of livestock feed by developing the types of plants that can be used as animal feed, i.e. *turi* (*Sesbania grandiflora*), *lamtoro or petai cina* (*Leucaena leucocephala*), *kaliandra putih* (*Zapateca tetragona*), wild pisang (*Musa parasidica*), *gamal* (*Gliricidia sepium*), *kaliandra merah* (*Calliandra calothyrsus*), king grass and tubers. The element of soil and water conservation is done not only on certain aspects, but rather it can provide space for the development of other sectors such as farms.

3.8.3 Harvesting Non-timber Products

Some parents teach their children about restrictions on the misuse of forests such as taking wood, destroying saplings and releasing livestock into the forest. With livelihoods in the agricultural sector, the ability to connect forest conservation with water systems can be mentioned as a measure of the existence of ecological wisdom. Yosada et al (2017) suggested the same for sustainability of natural resources.

With regard to soil and water conservation through social forestry approaches, local knowledge about the ways of farming and interacting with forests, soil and water needs to be re appreciated through various tools and regulation of social forestry development by taking into account:

- 1) Policies should be directed with the aim of revitalizing local utilization practices or initiatives in support of forest, land and water management.
- 2) Forest resource management practices should be objectively accommodated by local communities as a foundation for the implementation of forestry sector development in rural areas.
- 3) Rural communities should be the main actors of forest, land and water management processes and can ascertain the direction and objectives of the process.

In order to improve the appreciation and internalization of various agricultural practices of swamp forests by local communities for generations, some considerations are needed to be conditioned as follows:

- 1) The development of crop species should prioritize local crop species that have adapted to various patterns of community utilization along with social, economic, ecological, and rural cultural functions.
- 2) Forest, land and water management approach should recognize and represent approaches on tribes, household, farmer group and others.
- 3) Small scale forest units can be managed collectively by local groups while still providing roles and contributions to each household to contribute to individual management, as well as to be inherited based on customs and inheritance system which applies in rural communities.

- 4) Need revitalization and re-actualization of mixed based swamp forest and lands agriculture including reconstruction of customary rules that support sustainable forest, land and water management.

The successful key in various forest reforestation activities is very clear to the community as the subject of the perpetrator. Without a strong desire and a thorough understanding in the community about the importance of forest sustainability will lead to various reforestation efforts to be hampered, resulting in no results. Therefore, in addition to the review of the technical aspects such as the land and water conservation and rehabilitation aspects described above, it should also be discussed further on the conservation aspect of the culture itself. Socialization will certainly be faced with constraints such as modernization and technological progress and population growth. Therefore, possible steps to be taken include:

- 1) Schools can be utilized as a mediating tool and channel socialization formally optimized its function.
- 2) Government intervention and stakeholders have to invite the mass media, especially television and radio to become a channel of socialization.
- 3) A reward program for communities can be maintained as sustainability at the household level through indicators of community forest development.
- 4) A model village or pilot village in one community around the forest area should be created to stick to local initiatives.

4. Conclusions

Before 2000, rural community initiatives in swamp forests are known to have demonstrated strong interaction between rural communities, forest resources and the customary regulations still firmly held by the rural community. Various types of products extracted by priority are fuel material, food sources, medicine and pharmacy, materials for handicrafts, structures and other uses. After 2000, there have been significant changes in forest and land resources being used for other purposes, e.g. agroforestry, plantation, agriculture, fodder, leaves, thatching grass, resins, dyes, manure and others. These activities have caused degradation of swamp forest. To minimize the impact of swamp forest degradation, the active participation involvement of the rural community and all other stakeholder components is essential to optimize swamp forest management. The revitalization of rural initiatives is a strategic opportunity that can be utilized optimally in support of swamp forest managements. These efforts can be achieved through the identification of the potential to obtain a complete data base on rural initiatives available to support swamp forest managements. Other efforts can be pursued through policy approaches, namely by providing space for the re-functioning of existing rural initiatives through the integration of rural traditional codes into formal legal codes of environmental regulations.

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