Journal of Agriculture and Environmental Sciences
December 2016, Vol. 5, No. 2, pp. 8-14
ISSN: 2334-2404 (Print), 2334-2412 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jaes.v5n2a2
URL: https://doi.org/10.15640/jaes.v5n2a2

# Societal Role in Cultivating and Enhancing Peat Land Ecosystem Services: A case Study of Hampangen Forest in Central Kalimantan, Indonesia

**Francisca Kilonzi[1], Takahiro Ota[2]and Kazuhiko Moji[3] & Aswin Usup[4]**

**Abstract**

Ecosystem services comprises of the components of nature that are directly enjoyed, consumed, or used to yield human well-being. Traditionally they have been regarded as the source of livelihood to the surrounding communities. This paper takes a practical approach to examine the various tropical peat land forest ecosystem services obtained from the Hampangen Education Forest, in central Kalimantan, Indonesia, by focusing the quantity and the frequency at which the surrounding community uses them. From our findings, we identify a change from the mainstream conception of ecosystem service use to service to the ecosystem by the society through various activities. Tree seedlings keeping, fruit cultivation, fish farm projects, swiftlet farming and total lifestyle change are some of the community services to the ecosystem resulting to forest ecosystem services cultivation and enhancement.

**Keywords:** Ecosystem Services, Services to the Ecosystem, Peat land Forest, Central Kalimantan

## 1. Introduction; Ecosystem Services (ES) concept.

Various definitions have been proposed defining ES as the benefits people obtain from the ecosystem (Kurt Jax et al 2013, Jeffers, et al 2015). ES comprises of the components of nature that are directly enjoyed, consumed, or used to yield human well-being (Boyd J. et al 2006). They are provided to humans through transformation of natural resources commonly known as environmental assets into a flow of goods and services, (Constanza et al. 1997). Traditionally they have been regarded as the source of livelihood to the surrounding communities.

The Millennium Ecosystem Assessment (MEA) 2005 came up with a framework that identified and categorised ES into four; provisioning services such as food and water, regulating services such as climate regulation, supporting services like nutrient cycling and cultural services such as spiritual benefits. This paper focuses on the provisioning services obtained from the tropical peat land forest and the various activities done by the community to ensure ES enhancement and restoration, a case study of Hampangen Educational Forest (HEF), in central Kalimantan, Indonesia.

[1]Nagasaki University, Nagasaki, Japan. E-mail: franciscakarem@gmail.com
[2]Nagasaki University, Nagasaki, Japan. takahiro@nagasaki-u.ac.jp
[3]Nagasaki University, Nagasaki, Japan. moji-k@nagasaki-u.ac.jp
[4]University of Parangkaraya, Kampus Tunjung Nyaho, Jalan Yos Sudarso, Palangka, Jekan Raya, Kota Palangka Raya, Kalimantan Tengah 74874, Indonesia. E-mail: aswin@agr.upr.ac.id

### 1.1 Environmental Impacts of Over Utilization of Peat land Forest ES.

Peat lands cover an estimated 3% of the earth's land surface, whereby undeveloped tropical peat lands found in East Asia, South East Asia, central America, the Caribbean and southern Africa is 30-45 million hectares' equivalent to about 10-12 % of the global peat land ecosystem (Strack et al. 2008). In their natural conditions, most of tropical peat land forests act as carbon sinks, but forest clearance can convert them to great sources of carbon and lead to adverse impacts on climate (Rieley et al. 2008 Ch. 6., Phillips 1998).

In central Kalimantan, Indonesia, peat land area is 32% (4.78 million hectares) of the total peat land in Indonesia, (Osaki et al. 2016 Ch. 30). And just like other indigenous communities, the community in central Kalimantan has in the past relied on the peat land forest ecosystem for their survival (Nakashima et al. 2012, Gadgil et al. 1993). The epitome happened during the failed mega rice project in 1996; where by deforestation by use of fire took place for paddy rice cultivation leading to high emissions of carbon dioxide from the peat land, (Hayasaka et al. 2014, and Osaki et al. 2010). This gradually led to overexploitation and significant reduction of the primary peat land forest and its ES, (Page et al. 2002). To solve this problem, Indonesia has over the last decade imposed strict rules and regulations on peat land forests and given its priority in preparing methodologies and policies for Reducing Emissions from Deforestation and Forest Degradation and the Conservation and Enhancement of Forest Carbon Stocks (REDD+) which began in 2009, by giving support to the community in various activities to enhance peat land forest restoration (Yuliati et al. 2012, Osaki et al. 2016 Ch. 39).

## 2. Study area description: HEF.

HEF was established by the Indonesian Ministry of Forestry, based on the decree No. 311/Kpts-II/1993, on June 17, 1993. The total area of the HEF is 5,000ha, managed by collaboration between Forestry Department of Katingan Regency and University of Palangka Raya. HEF was selected as the study site because it is one of the research sites of the tropical peat land in Central Kalimantan, and very important source of peat land forest ES. Fig. 1 shows cross-sectional view of HEF and the riparian three villages where the data was collected.

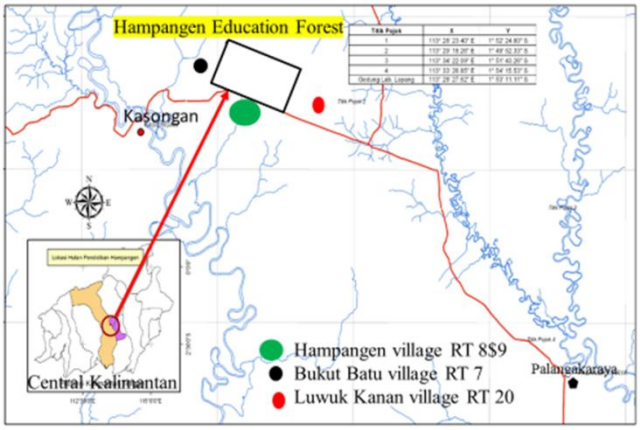


**Fig.1: HEF in Central Kalimantan. Complied by authors**

The survey was conducted in three villages surrounding the HEF; Hampangen village, Luwuk Kanan village and Bukit Batu village. The villages are further subsided into smaller units called Rungkun Tetangga (RTs). In total 4RTs, closest to the forest and whose people depend on the forest for livelihood were chosen comprising of a total of 199 households. Hampangen village borders HEF in the southern part comprising of total of 9 TRs, however we focused only on RT 8 and RT 9 with a total of 112 households, located near the HEF and depend highly on the forest for their livelihood. In Luwuk Kanan village we selected RT 20 with a population of 56 households and Bukit Batu village, RT 7 with 31 households near the HEF to the south was selected. In total, 145 house household were interviewed representing 73% of the mother population.

### 2.1 Methods and Materials

The data was collected in two seasons, from February to April 2016 (wet season), and from July to September 2016 (dry season). To fully achieve our objectives, it was necessary to carry out the survey during the two seasons since various ES are determined by the two seasons. In wet season, planting and harvesting activities take place, in dry season, peat land clearing and farm preparations are common with frequent forest fires (Osaki et al. 2016 chapter 6, Page et al. 2002, Spessa et al. 2015). The ES identification data was collected by use questionnaires and interviews to the respondents from three villages. The respondents were asked to mention various ES, the frequency at which they get them from the HEF, and the amount to indicate either home consumption or for sale. Use of photographs to show visually various ES was also common. To assess the most valuable ES, we used the people's preference based approach to identify the most preferred ES, (Kerry et al. 2002), by identifying the frequency at which the ES are obtained such as daily or weekly rather than cost based approach that measures the cost of providing the ES instead of its value (Silvio et al. 2016).

## 3. ES Identification and Quantification from the HEF.

Many ecosystems are already under stress due, over utilization, land use activities, mismanagement among other issues, (Sebastian et al. 2016, and Costello et al. 2010). Nevertheless, we carried out a survey in the villages identifying the ES the amount obtained from HEF and the frequency. However, we learnt that the communities barely use forest and the limited ES are obtained in a sustainable manner. A factor that has made HEF retain its primary forest which is 40% and its secondary forest 60%. The most frequently used ES were fish for home consumption, tree seedlings for nursery beds, wood for house construction and cooking, birds, tannin for sale, herbs for medicinal use among others. In terms of frequency, fish collected from the river streams and peat ponds on daily and weekly basis recorded the highest, followed by wood and thirdly birds for home keeping, a traditional custom common among the Dayaks. Tree seedlings collection for sale in the nursery bed was frequent activity in most of the interviewed respondents. Table 1 shows detailed explanation of the ES from HEF.

**Table 1: Provisioning Ecosystem services obtained from the HEF.**

| ES | Frequency | Purpose | Description. |
|---|---|---|---|
| Fish. | Daily | Domestic consumption | Caught from the peat swamps, canals and rivers stream in HEF, 3-5kg. |
| Wood | Daily | For cooking | Average of 6 Kg of dead wood is collected |
| Tannin. | Yearly | 1kg sold at 50USD. | Tapped from mature rubber trees of about 8-10 years old whereby 1ha, produces about 100kgs of tannin. |
| Palm oil. | Yearly | Sell | Harvested from palm oil trees of secondary forest in HEF for making palm oil. |
| Timber. | Seldom | Home use | Used for constructing houses, building boats and furniture. The trees to be cut should be about 3.8 Meters tall and below. |
| Herbs/medicinal products. | Occasionally | Home use | Various are herbs collected from the HEF for treatment of various ailments such; asthma, diabetes, bone injuries and mosquito bites. |
| Birds. | Weekly | Home beauty | Several bird species are collected in the HEF most common being plain throated sunbird (Anthreptes malacensis) for home beauty. |
| Rattan | Daily | Food | Common delicacy consumed as leaf vegetable daily harvested freely from the HEF. |
| Tree seedlings. | Monthly | Sell | Collected from the forest then planted in a nursery for sell. Used for reforestation programs. |

Complied by the authors

## 4. New insights: Positive Interaction between the Society and HEF.

Our primary objective was to identify various ES in HEF, however we found out that the communities around the forest barely use the ES, instead they focus on various activities that enhance the restoration of the forest and enhancement of its ES. We interpreted those actions as societal roles in enhancing and cultivating ES, as a result of understanding the value of value of nature (peat land forest), (Kerry et al. 2002,MEA 2005, Krutilla 1967, Westman 1977 and Mooney et al. 1997 ). This section discusses the identified activities that the community around HEF has been undertaking to directly or indirectly enhance the quantity of ES.

### 4.1 Tree seedling planting.

The research showed that in Hampangen village, 70% of the total households had a nursery bed with various tree seedlings collected from the HEF. This can be attributed to the physical location of the forest, offering quicker access, cheaper and less tedious transportation of the seedlings from the forest. The seedling species depend on the availability of the various wild tree species in the forest and the knowledge to identify them. After collection, the seedlings are kept in plastic bags in the nursery and taken care of before being transplanted to the forest for reforestation purposes or sold to the government and other customers for economic gains. The main reason for the focus on tree nursery bed is because of the closure of timber related companies in the area result of government regulations (Osaki et al. 2010). One of the respondents said that before he was harvesting timber from the HEF but due to strict government laws, he shifted to tree seedling planting.

### 4.2 Fish Farm Groups.

Several fish groups were identified in the villages for both economic and domestic consumption purposes. The two most active being *Hampangen Indah* group and *Maneser Panatau* group in Hampangen. These groups are composed of ten members whose income should not be more than 6 USD per day, they should come from the same village and commit to enhance tropical peat land conservation. The government offers training to three members of each group on fish farm management and a financial support of up to 200 USD inform of fish equipment and materials is given for the start of each project. These projects provide alternative source of fish resulting to enhancement of fish quantity in the natural river streams in HEF. Each fish group has 6-10 pools of fish ranging from 1 month old to 7 months old. About 90% of the respondents said that there has been no reduction in quantity of fish catch from the natural peat swamps in HEF, a factor that can be attributed to the introduction of these projects.

### 4.3 Fruit cultivation.

To avoid over reliance on forest ES, farmers in central Kalimantan have resulted to fruit cultivation as an alternative source of food and income. The major fruits cultivated in the villages include: pineapples, grown on the dry peatland, watermelon, mangos and peanuts (BPS 2015). In terms of production, watermelon recorded the highest in 2015, followed by pineapple and peanuts and mangos recorded the lowest as shown in Fig.2 below.

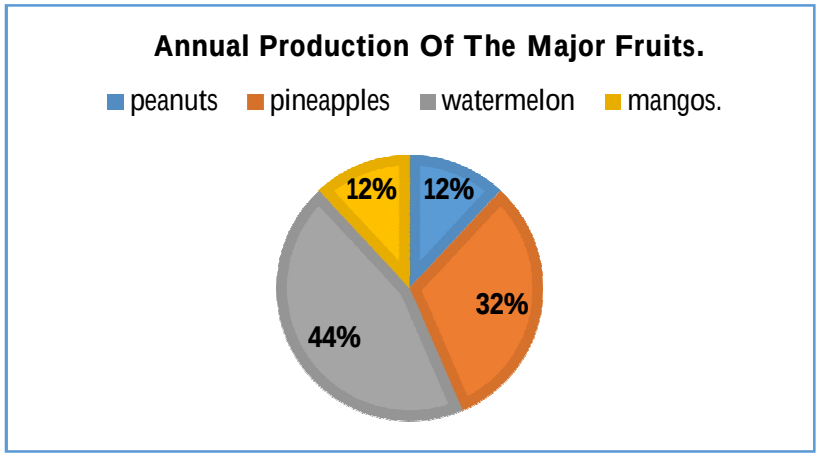


**Fig 2. Major fruits grown on the peat land in Kasongan regency. Source; BPS 2015.**

### 4.5 Swiftlet farming.

Swiftlet farming began five years ago, in central Kalimantan, having originatedin Malaysia and other parts of Indonesia, as a business that has currently spread in the whole of south East Asia region.

Swiftlets nest are edible with high market value sold mainly in China, Taiwan, Hong Kong, Canada, USA among other countries. We carried out a survey to identify the impact of this business on ES restoration having mentioned as an alternative source of livelihood by the respondents. To identify the swiftlet buildings, physical counting and location of the buildings was mapped using GPS as shown in Fig.4, the area with concentrated dots indicates highest number of the buildings. Kasongan town recorded the highest number of buildings with more than 100 households owning at least one. This is due to its urban location hence fast information exchange mainly from the neighbouring towns.

In terms of good breeding conditions, the temperature should be regulated at a range of 25 to 35 degrees for the swiftlets comfort and relative humidity between 75% to 90%. Lower relative humidity leads to drying of the swiftlets saliva which leads to cracking of the nest (Ibrahim S.H et al 2009). Fig. 3 showing various designs of the swiftlet nest buildings identified in central Kalimantan.

**Fig. 3: Various Swiftlets nest buildings. Complied by authors.**

Harvesting takes place one year after the birds settle in the building, till then the houses are kept locked, this is to attract more swiftlets to fly into the house and allow growth of the swiftlet population. Swiftlet take around 30-45 days to build the nest and 3-7 days to lay the eggs which are hatched after 3-4 weeks then after about 45-60 days the birds can fly out, (Alias et al 2013, Lim 2007 and Francis 1987). The birds leave early in the morning around 5 am to search for food and return in the evening at around 6pm.

The Economic significance is determined by the quality of the nest, the best quality goes at a market price of 10 Million Rupiah per Kilogram, whereby every harvest gives an average of 6 Kilograms resulting to 60 Million Rupiah per harvest on annual basis. Only 30% of the total respondents interviewed have harvested the nests in this area while the rest are yet to get their first harvest. This activity offers alternative source of income hence reduction in ES use from HEF.

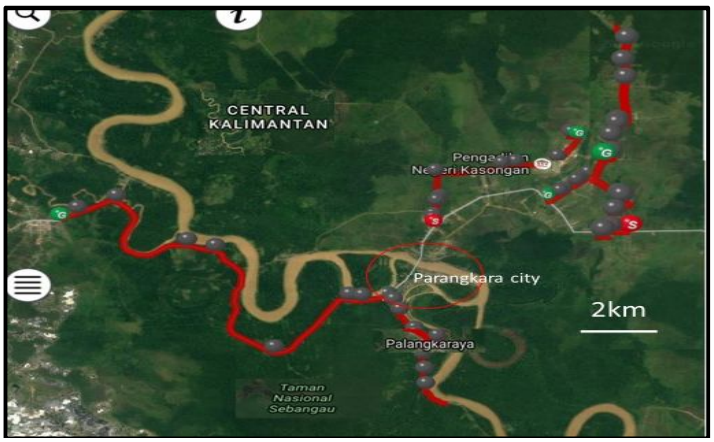


**Fig 4.GPS navigation route and swallow bird location mapping, Authors mapping.**

## 6. Conclusion.

Our aim was to identify the ES in HEF and their usage by the surrounding community; however, limited ES were identified to be used. This is because of the strict rules and regulations from the government on peat land forest use (Hayasaka et al. 2014 and Yuliati et al. 2012), that prohibited the communities from the use of forest related products resulting to the search of alternative sources of income. The attention has now shifted to service to the peat land forest ecosystem with the aim of enhancing forest restoration, an indication of communities' great stride in awareness of the value of natural peat land ecosystems and the need to conserve and restore it. These activities carried out by the communities in central Kalimantan and the sustainable use of ES bring out an important viewpoint that human beings are playing a significant role in cultivation and enhancement of the natural peat land forest ES. These societal activities are an indication of shift from the mainstream conception of peoples overly dependence on the natural ES to giving back to the ecosystem.

## 7. Acknowledgement.

We appreciate the financial support offered by the Environmental Research and Technology Development Fund (4-1506) of the Ministry of the Environment, Japan during the field exercise.

## 8. References

Anuar A., Ang Y. P., Nurul Z., and M. Azizi. (2013). Investment in swiftlet hotels in Malaysia – Does ROI compensate investment risks? African Journal of Business Management Vol. 7(38), pp. 3936-3943.

BPS. 2015. https://www.bps.go.id.

Comberti, C., T.F. Thornton., V. Wyllie de Echeverria., T. Patterson. (2015). Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems. Global Environmental Change, Volume 34, September 2015, pp 247–262.

Costello, M.J., M. Coll, R. Danovaro, P. Halpin, H. Ojaveer, P. Miloslavich, (2010) A census of marine biodiversity knowledge, resources, and future challenges. PLoS. One, 5.

Costanza R, d'Arge R, De Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P and Vandenbelt M. (1997). The value of the world's ecosystem services and natural capital. Nature 387:253–260.

Francis C. M. (1987). Hatching asynchrony and egg-size variation in white-bellied swiftlets (Collocaliaesculenta). MSc Thesis, Queen's University, Kingston.

Gadgil, M., F. Berkes., C. Folke. (1993). Indigenous knowledge for biodiversity conservation. Ambio, 22 (2–3): pp. 151–156.

Hayasaka, H. et al., Peat-fire-related air pollution in Central Kalimantan, Indonesia, Environmental Pollution (2014).
James, B. and B. Spencer. (2006). What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units. Resources for the Future, 1616 P St. NW Washington, DC 20036 202-328-5000
Jax, K., D.N. Barton., K.M.A. Chan., R. de Groot., U. Doyle., U. Eser. (2013). Ecosystem services and ethics. Ecol. Econ., 93 (2013), pp. 260–268
Jeffers, E. S., S. Nogué., K.J. Willis. (2015). The role of palaeo ecological records in assessing ecosystem services Quat. Sci. Rev., 112, pp. 17–32.
Kerry, R T., Jouni Paavola, Philip Cooper, Stephen Farber, ValmaJessamy, and Stavros Georgiou. (2002). Valuing nature: lessons learned and future research directions. CSERGE Working Paper EDM 02-05.
Krutilla, J.V. 1967. Conservation reconsidered American Economic Review, 57 (1967), pp. 777–786.
Lim C.2007. Make Millions from Swiftlet Farming: A Definitive Guide. Kuala Lumpur: True Wealth Publishing. ISBN: 978-983-3364-25-1.
Millennium Ecosystem Assessment (MEA) (2005), Ecosystems and Human Well-being: Current State and Trends, Island Press, Washington, D.C.
Mitsuru Osaki and Kazuyo Hirose. (2010). Some Topics of REDD plus and MRV in Indonesia. Center for Sustainability Science (CENSUS), Hokkaido University.
Mooney H.A. and P.R. Ehrlich. (1997). Ecosystem services: a fragmentary history. G.C. Daily (Ed.), Nature's Services: Societal Dependence on Natural Ecosystems, Island Press, Washington D.C. pp. 11–19.
Nakashima, D. J., K. Galloway McLean., H.D. Thulstrup., A. Ramos Castillo., J.T. Rubis. (2012). Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation, UNU, Paris UNESCO and Darwin.
Osaki, M., and N. Tsuji. 2016. Tropical Peat land Ecosystems, Springer Tokyo Heidelberg New York Dordrecht London. Chapter 6. Osaki, M., B. Setiadi., H. Takahashi and M. Evri. (2016), Peat land in Kalimantan. Pp 91-112. Springer Tokyo Heidelberg New York Dordrecht London.
Osaki, M. and N. Tsuji. 2016. Tropical Peat land Ecosystems, Springer Tokyo Heidelberg New York Dordrecht London. Chapter 30. Takeuchi, W., T. Hirano and O. Roswintiarti. (2016), Estimation model of ground water table at peat land in central Kalimantan, Indonesia. Pp 445-453. Springer Tokyo Heidelberg New York Dordrecht London.
Osaki, M., and N. Tsuji. 2016. Tropical Peat land Ecosystems, Springer Tokyo Heidelberg New York Dordrecht London. Chapter 39, Y. Yamamtoto and K. Takeuchi (2016), The potential for REDD+ in peat land of central Kalimantan, Indonesia. Pp 599-612.
Osaki, M. and Kazuyo Hirose. (2010). Some Topics of REDD plus and MRV in Indonesia. Centre for Sustainability Science (CENSUS), Hokkaido University.
Page, S. E., Siegert. F., Rieley, J. O., Boehm, H. D. V., Jaya, A., and Limin, S. (2002). The amount of carbon released from peat and forest fires in Indonesia during 1997, Nature, 420, 61–65.
Phillips, V.D (1998). Peat Swamp Ecology and sustainable development in Borneo. Biodiversity and Conservation 7;651-671.
Sebastian V., Priscila F.M. Lopesc, and Marta Colle (2016). The role of marine ecosystem services for human well-being: Disentangling synergies and trade-offs at multiple scales.Ecosystem Services, Volume 17, February 2016, Pages 1–4.
Strack, M. (2008). Peatlands and Climate Change. International Peat Society, Vapaudenkatu 12, 40100 Jyvaskyla, Finland.Chapter 6: Tropical Peatlands: Carbon Stores, Carbon Gas Emissions and Contribution to Climate Change Processes J.O. Rieley, R.A.J. Wüst, J. Jauhiainen, S.E. Page, H. Wösten, A. Hooijer, F. Siegert, S.H. Limin, H. Vasander and M. Stahlhut. Pg. 148- 181.
Spessa, A. C., R. D. Field., F. Pappenberger., A. Langner., S. Englhart., U. Weber., T. Stockdale., F. Siegert., J. W. Kaiser., and J. Moore. (2015). Seasonal forecasting of fire over Kalimantan, Indonesia. Natural Hazards and Earth System Science, 15(3) pp. 429–442.
Silvio J. Crespina, Javier A. Simonettia. (2016). Loss of ecosystem services and the decapitalization of nature in El Salvador. Ecosystem Services. Volume 17, February 2016, Pages 5–13.
Westman, W.E. How much are nature's services worth? Science, 197 (1977), pp. 960–964.
Yulianti, N., H. Hayasaka and A. Usup. (2012). Recent Forest and Peat Fire Trends in Indonesia. The Latest Decade by MODIS Hotspot Data. Global E.S.