INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 10, No. 6, p. 107-114, 2017
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Strategy for agroforestry development on peatland conservation in Kalampangan village, Central Kalimantan province, Indonesia

Daniel Itta*

Faculty of Forestry, Lambung Mangkurat University, South Kalimantan, Indonesia

Article published on June 11, 2017

Key words: Agroforestry, Peatland, Brown economic

Abstract

Peatland is a typical ecosystem in terms of structure, function and vulnerability. Irresponsible utilization of peatland will lead to the loss of one of precious resources since peatland is non-renewable. As reported, in Central Kalimantan are seen many *bongkor* (sleeping lands), the degraded peatlands resulted from subsidence, which were then left or abandoned by the managements. Peatlands require different management than other lands. Therefore it is important to research how peatland management strategies, in order to avoid the occurrence of damaged peatlands. The utilization of natural resources should be carried out in optimal and environmentally friendly ways because the optimal utilization will support local economy. The purpose of this study was to analyze the stages of agroforestry management and the economic value on peatlands. The method used in this study was a direct survey in the field. Data collection techniques in this study were by interviews, observation and literature. Purposive sampling was used to select the study location. The results showed that the strategy for peatland conservation was the management leading to sustainability and compliance and having economic value in order to improve the welfare of the community. This strategy refers to Brown Economic (adaptability, product ability and sustainability) and to the stages of the management that minimize the subsidence when peatlands are being managed. With agroforestry system and management on peatland, it is expected that the peatland conservation will improve the social welfare and environmental sustainability.

***Corresponding Author:** Daniel Itta ✉ ns.prihatini@unlam.ac.id

Introduction

Peatland is a typical ecosystem in terms of structure, function and vulnerability. Irresponsible utilization of peatland will cause a loss of one of precious resources because peatland is non-renewable. As reported, in Central Kalimantan are seen many *bongkor* (sleeping lands), the degraded peatlands resulted from subsidence, which were then left or abandoned by the managements. Peatlands require different management than other lands (Notohadiprawiri, 2006). The utilization of peatland by various parties has led to numerous damages. Therefore, the Minister of Agriculture issued Regulation of the Minister of Agriculture No.14 of 2009 on Guidelines for Peatland Utilization for Oil Palm Cultivation (Alwi and Hairani, 2007).

One of the government programs to rehabilitate the peatlands of one million hectares ex peatland project is through a community forest program. This program is expected to overcome the damaged lands whose trees have been cut down so that they can be restored and productive for the needs of the community and is expected to rehabilitate the environmental conditions that have been damaged.

Agroforestry pattern is a land use system that involves socially and ecologically acceptable integration of trees with agricultural crops and/or animals simultaneously or sequentially, which is expected to increase the productivity of crops and animals on an ongoing basis from the farm units, especially under conditions of simple technology and marginal land (Lahjie, 2004). Agroforestry is a very complex system formation and cannot be understood partially only by its components (ICRAF, 2000). The interaction between the components requires a comprehensive reasoning by taking intoconsiderations all components simultaneously. Agroforestry pattern has ecological, economic and social benefits. Some of the benefits are the pressure reduction on forests, more efficiently recycling of nutrients, the increase in soil nutrients and the improvement of soil structure; the improvement of the sustainability of firewood food, fodder and wood carpentry; the increase in farmers' income, as well as the improvement of nutrition and health by improving the quality and the diversity of food products (Lahjie, 2004).

Therefore, it is considered necessary to conduct a study to calculate the economic value from an agroforestry program through a study of strategic analysis of peatland management and economic value in order to increase social welfare (Suprayogo *et al.*, 2003).

The purpose of this study was to analyze the stages carried out in the management of peatland and the economic values through agroforestry pattern. It is expected that the stages of peatland management can maintain the balance of environment.

Materials and methods

The study was conducted in Kalampangan Village, Sabangau District, Palangkaraya City, Central Kalimantan province.The study procedures consisted of three phases of activities: preparation, data collection and data analysis. Data collection techniques in this study were by interviews, observation and literature. Purposive sampling was used to select the study location.

Types of data collected in this study were: Primary data consisting of a) the information obtained by restructuring interviews with farmers, b) the general condition of agroforestry sites on peatland, and c) the biophysical measurements, namely the soil analysis.Secondary data including a) literature and b) internet browsing.

Statistical analysis

Data were analyzed descriptively based on the collected data to determine the stages of activities in the management strategy of agroforestry pattern on peatland.

The analysis of the economic value of agroforestry pattern was made through a Present Value (PV).

Results and discussion

The results of the study indicated that if the thick peatland was managed properly and accordingly, it could give good results in the long term although the costs were quite high. Furthermore cropping pattern of agroforestry on peatland can be seen in Table 1.

Table 1. Cropping pattern of agroforestry on peatland.

Code	Description
B -1	One month prior to the staple crop planting, the land was prepared (without opening the whole land, just enough for the staple crops)
B 0	Planting the staple crops
B +12	12 months after planting, the land for intercropping was prepared
B +13	13 months after planting, the provision of ashes, manure, and lime was carried out.
B +13	13 months after planting, the intercrops were planted.
B +14	14 months after planting, the maintenance was conducted (the second stage of the fertilizer provision)
B +15	15 months after planting, the harvest of intercrops was done (particularly the mustard due to its short lifespan)

Description: The length of the periodization may change depending on the age of intercrops.

CO_2 emissions can be reduced by adjusting the cropping patterns, particularly for food crops and vegetables. In principle, the purpose of the cropping patterns on peatland was to reduce the time length of the soil in open condition triggering emission. Relay planting is one example of the application of the cropping patterns that allows the peat soil unopened when the next replacement of crops are carried out. However, the intercrops between staple crops (annually) can reduce the organic acids in the forms of CO_2 and NH_4. These results strongly agree because trought this stage can avoid the length of the soil open condition triggering emission.

Table 2. Production and farmer's income from intercrops on peatland in Kalampangan village of Sabangau district, Central Kalimantan.

No	Intercrops	Production/ha	Price (IDR)	Income (IDR)
1	Corn (cob)	67,331	1,500	100,996,875
2	Mustard (kg)	17,062,500	9,500	162,093,750
3	Chili (kg)	2,100	30,000	63,000,000
4	Leek (kg)	8,575	13,000	114,475,000

Source: Primary Data 2013.

According to Hairiah *et al.* (2000) the farming continuously practiced will reduce the total reserves of C and N in the soil. However, if there is fallow period, the condition will gradually recover. Through the fallow process the elements of C and N will be created for the nutrients needed for the crops. Of all the nutrients, the N element is required in the largest amount but its availability is always low because its mobility in soil is very high.

The ability of the soil to provide the nutrient N is determined by the condition and the amount of soil organic matter. According to Hairiah *et al.* (2000), the fallow period basically has two functions:

Improving physical, chemical, and biological fertility of soil (including the prevention of pests and diseases) required for the next planting period.

Producing certain products that increase the farmers' income for example fodder, firewood, medicines, honey and so on.

A. Concept of Brown Economic

Agroforestry pattern is one of the alternatives to overcome the environmental damages with the concept of Brown Economic (Itta and Arifin, 2013). As a new definition that has not been in the environmental economics literature, the economic brown is interpreted as follows:

Returning the function of the soil.
Restoring the function of hydrology.
Both contain the elements of Adaptability, Productibility and Sustainibility.

Table 3. Total income from intercrops for one planting season on peatland in Kelampangan village of Sebangau district of Central Kalimantan province.

No	Crop Species	Income (IDR)
1	Corn	33,665,625
2	Mustard	32,418,750
3	Chili	31,500,000
4	Leek	28,868,750

Source: Primary Data 2013.

According to the Itta and Arifin (2013), the economic brown concept can be used for:
Restoring the environmental conditions of degraded peat forests.

Providing carpentry wood supplies. Reducing the pressure of forest resources (peatlands)

Improving the empowerment of forest fringe communities through social mapping for rural development.

The concept of brown economic is a manifestation of the development of adaptability, productibility and sustainability. Brown economic is expected to replace the conventional economic model that is not environmentally friendly. Furthermore, brown economic is intended to synergize the three basic values, namely Adaptability, Productibility and Sustainability.

Agroforestry on damaged peatlands should refer to the theory of brown economic in order to obtain the benefits, both for the environment and for the improvement of community welfare.

Table 4. Net income for one harvest season on peatland in Kalampangan village of Sabangau district of Central Kalimantan province.

No	Crop species	Income (IDR)	Cost (IDR)	Benefit value (IDR)
1	Corn	33,250,500	8,775,000	24,475,500
2	Mustard	32,760,000	4,950,000	27,810,000
3	Chili	31,500,000	13,875,000	17,625,000
4	Leek	28,618,750	7,175,000	21,443,750

Source: Primary Data 2013.

The goal of Brown economic is to develop the quality of peatland in order to increase the welfare of the society. There are three focuses of brown economic: a) ecology, b) social, and c) economy. The three elements should contain three basic values, namely adaptability, productibility and sustainability.

There is always a balance in brown economic between the development and the environmental capacity that would affect public welfare. Brown economic concept can conserve biological diversity of peatland and provide economic benefits to the welfare of the people in the surrounding area of peatland.

Brown economic theory is an economy theory that is not detrimental to the environment. Brown economic concept complements the concept of sustainable development. The main principle of sustainable development is to meet the needs of future generations; therefore, it can be said that brown economic is the main motor of sustainable development. The values contained in brown economic are economic, ecological and environmental values referring to adaptability, productibility and sustainability.

Table 5. Agroforestry pattern with a combination of two intercrop species on peatland in Kalampangan village of Sabangau district, South Kalimantan province.

No	Crop Species	Income (IDR/ha)	Cost (IDR/ha)	Benefit Value (IDR/ha)	B/C
1	Jelutung + Corn	32,760,000	8,775,000	24,475,500	3.7
2	Jelutung + Mustard	33,250,500	4,950,000	27,810,000	6.7
3	Jelutung + Chili	31,500,000	13,875,000	17,625,000	2.3
4	Jelutung + Leek	28,618,750	7,175,000	21,443,750	3.9

Source: Primary Data 2013.

The instrument of brown economic is a successful management of peatland for the people's needs with the fundamentals of adaptability, productibility and sustainability without damaging the environment. The variables used in brown economic concept are the peat maturity level, crop species and management system. The peat with lower composition of sapric (mature peat) makes the organic acids such as CO_2 become lower due to the low content of C and N (decomposition) compared with the immature peat (pibric) which contains high elements of N and C. The composition level of pibric containing the elements C and N is high and if added with urea, it will lead to the formation of organic acids in the form of CO_2 and NH_4. Based on the analysis, the modeling of agroforestry on peatland refers to four elements, as follows:

Brown economic theory that refers to a) adaptability, the ability of a crop species to adapt to the environment of peatland area, b) productibility, the ability of a crop species to produce yields resulting in the benefit values either directly or indirectly, c) sustainability that means how a land can be cultivated in the long term and how it is able to maintain its balance so that the crops can produce and provide benefit values.

Public perception of the society around the peatland. The society should be equipped with enough knowledge about how to manage peatland in proper ways. There are ongoing coaching activities carried out to help people understand how to manage peatland that is very vulnerable to the environmental damages due to its unique properties. The communities surrounding the peat area should be assured that peatland can be cultivated for agricultural land in appropriate techniques and with always keeping the economic, ecological and social values.

Agrisilvicultural system. The pattern is a combination of forest trees (timber) and agricultural crops (non-timber).

Total economic value. When the total economic value is greater than the social costs, the peatland area can be cultivated for agriculture with agroforestry model, but if the total economic value is lower than the social cost, the peatland area should be maintained as a conservation area.

B. Agroforestry System on peatland

The income derived from each type of intercrops can be seen in Table 2.

The harvest age of crop species is different from each other. Corn is harvested three times a year, mustard five times, chili two times and leek four times. The production and the income as shown in the table above is for one year per hectare. The highest income earned during the year in one hectare was for mustard (IDR 163.8 million) and the lowest was for chili (IDR 63 million). However, if the income was calculated only for one harvest season, the combination of corn and jelutung provided greater income (IDR 32.25 million/ha), as shown in Table 3.Corn earned the highest income of IDR 33.25 million/-ha and leek earned the lowest. If it was calculated economically, the pattern of jelutung with mustard was the best since the harvest age of leek was just 40 days compared with corn aged about 90 days or leek approximately 60 days. The combinations of two crop species that provided the highest benefit value for one harvest season, after deducted by the costs, are shown in Table 4.

The intercrop species which gave the highest economic benefit value was mustard up to IDR 27.81 million/ha/harvest season.

The combinations of agroforestry patterns of the four intercrop species in detail are described in Table 5 - Table 7.

The agroforestry pattern with a combination of two crops providing benefit value after deducted by the cost was agroforestry pattern of jelutung and mustard with the value of B/C > 1 that was 6.7, indicating profitable.

The highest benefit value of mustard resulted from the lower operational cost for cultivating the mustard compared to the other crops. The analysis of the agroforestry pattern with a combination of three crop species providing the highest benefit value are described in detail in Table 5.

The pattern of agroforestry with a combination of three crop species that provided the highest benefit value was agroforestry pattern of jelutung, corn and mustard with the economic benefit value for one harvest season of IDR 52.285 million/ha/season, with a value of B/C > 1 of 4.8, which meant profitable. The analysis of the agroforestry pattern with a combination of four crop species in detail can be seen in Table 6.

Table 6. Agroforestry pattern with a combination of three intercrops on peatland in Kalampangan village of Sabangau district of Central Kalimantan province.

No	Crop Species	Income (IDR/ha)	Cost (IDR/ha)	Benefit Value (IDR/ha)	B/C
1	Jelutung + Cr + M	66,010,000	13,725,000	52,285,000	4.8
2	Jelutung + Cr + Ch	64,260,000	22,650,000	41,610,000	2.8
3	Jelutung + Cr + L	61,378,750	15,950,000	45,428,750	3.8
4	Jelutung + M + Ch	64,750,500	18,825,000	45,925,500	3.4
5	Jelutung + M + L	61,869,250	12,125,000	49,744,250	5.1
6	Jelutung + Ch + L	60,118,750	21,050,000	39,068,750	2.9

Source: Primary Data 2013

Description: Cr= Corn, M = Mustard, Ch = Chili, L = Leek.

The pattern of agroforestry with a combination of four crop species (intercropping) providing the benefit value after deducted by the cost was the agroforestry pattern of jelutung + corn + mustard + leek with the economic benefit value for one harvest season of IDR 73,729,250/ha/season, with the value of B/C > 1 of 4.5, which meant profitable.

The agroforestry patterns described in Table 4 - 6 were the patterns with the system that the area was divided into plots with the size of 2 m x 50 m = 0.01 ha. The area of one hectare was developed with a pattern of two combinations up to five combinations of crop species.

These patterns were developed based on the observation that the farmers' fields with such a system would be beneficial because the farmers could sell not only one but several crop species. It was also intended to avoid much loss when one of the crop species was attacked by diseases that caused some harvest failure because the crops were susceptible to pests and diseases. In addition, it was also expected to protect the farmers from getting trapped in price games by middlemen when there was over-load of one crop species that made the price fell. The other crop species would cover the falling price of that species.

Table 7. Agroforestry pattern with a combination of four crop species on peatland In Kalampangan village of Sabangau district of Central Kalimantan province.

No	Crop Species	Income (IDR/ha)	Cost (IDR/ha)	Benefit Value (IDR/ha)	B/C
1	Jelutung + Cr + M + Ch	97,510,500	27,600,000	69,910,500	3.5
2	Jelutung + Cr + M + L	94,629,250	20,900,000	73,729,250	4.5
3	Jelutung + Cr + Ch + L	92,878,750	29,825,000	71,978,750	3.1
4	Jelutung + M + Ch + L	93,369,250	26,000,000	67,369,250	4.0

Source: Primary Data 2013.

One of the obstacles that arose in the community was the price games controlled by middlemen. The standard price was determined by the middlemen who came to the field to buy the crops from the farmers.

The farmers realized that sometimes their crops were valued lower than the market price, but they still took such market pattern because they no longer would have to bother themselves with their crops after harvested. The buyers directly came to the location and the farmers got the payment for their crops once the harvest yields were weighed. It indicated that farmers just saw it from the term of simplicity.

Conclusion and Suggestions

In Conclusion, strategy for agroforestry development on peatland refers to the concept of *brown economic* in order to restore the environment condition, to fulfill the supply for carpentry woods, to reduce the pressure on forest resources and to improve the empowerment of the community in the forest fringe through social mapping for rural development.

The pattern of agroforestry was able to provide economic value in order to improve the welfare of the farming community by regarding the concepts of adaptability, productibilty and sustainability.

The utilization of deep peat requires knowledge about proper farming techniques and more caution so as it will not cause unintended environmental impacts. The management system refers to the system of relay planting in which the peat soil is not entirely open to reduce the increase in CO_2 emission. The selection of crop species on peatland should always be based on the criteria of crop's ability to adapt to the environment of peat so that it is able to produce yields (able to provide economic value). Since the nature provides incentives for human needs, it is necessary to take wise and prudent management to maintain the natural balance to keep the sustainability for production and ecological functions.

References

Alwi M, Hairani A. 2007. Chemical Characteristics of Shallow Peatland and Its potential for chili and Tomato Cultivation. Indonesian Journal of Agronomy**, 35(1)**, (2007).

Itta D. 2013. Economic Valuation of Agroforestry on peatland of Ex Transmigration in Kalampangan Village of Sabangau District of Palangkaraya City of Central Kalimantan Province. Doctoral Dissertation at Agricultural Faculty of Brawijaya University. 2013. Unpublished.

Hairiah K. 2000. Management of Acid Land In Biological Way. Reflection of Experience from North Lampung. *International Centre for Research in Agroforestry*. Bogor.

Itta D, Arifin YF. 2013. Agroforestry Pattern on peatland of Ex-Transmigration in Kalampangan Village of Sabangau District of Palangkaraya City of Central Kalimantan Province. Journals International Organization of Scientific Research **4,** p-ISSN: 2319-2399.

ICRAF, 2000. International Center for Research in Agrofofrestry.

Lahjie AM. 2004. Agroforestry Engineering. Mulawarman University, Samarinda.

Notohadiprawiri T. 2006. Development Ethics Peatlands for Agriculture Review. Lokakarya Food Crops Development Enviroment Peatland Hearts Palangkaraya. Enviromental Infact Control Agency.

Suprayogo D. 2003. An Analysis of Agroforestry Components as Keys for Success or failure of Land Use. World Agroforestry Centre (ICRAF). Bogor.