ISBN : 978-602-98439-7-2

PROCEEDINGS

International Seminar

IPB

PERMAMA

Food Sovereignty and Natural Resources in Archipelago Region

ISBN 978-602984397-2

ICC-IPB Botani Square
23th -24nd Oct-2012

PROCEEDINGS
International Seminar
"Food Sovereignty and Natural Resources in Archipelago Region"
PEMAMA

PROTECTED GARDEN AS AN ALTERNATIVE CONSERVATION TREATMENT IN WATERSHED UPSTREAM

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Abstract

The rate of deforestation in Indonesia continues to occur despite the recriminations that deforestation and degradation have increased or decreased. However, even though allegation has occured, degradation will always continue to occur in Indonesia. This will affect the watershed upstream that has a function as a conservation area on water resources. Protected garden is one of conservation models towards the watershed upstream either in economic aspect towards the community directly involved or ecology aspect towards the conservation of water and soil resources.
Keyword : *protected garden*

INTRODUCTION

The increasing rate of deforestation in Indonesia from years to years has caused the increase of degraded land size. It was estimated that the rate of deforestation in the year of 1990-1997 was 1,6 to 2 million ha/ year (Forestry Ministry, 2000). In 1997-2000 in 5 major islands, namely, Sumatra, Kalimantan, Maluku, Sulawesi, and Irian Jaya, the rate was 2,83 million ha/ year in forest area and 0,68 million ha/ year in non forest area (Forestry Department, 2003). Meanwhile, in line with the increase of deforestation rate, degraded land size was totaled about 48,5 million ha, consisting of 26,6 million ha of degraded land in forest area and 21,9 million ha of degraded land in non forest area (Anonymous, 2000). Another report said that the degraded land size in forest area was approximately 54,6 million hectares and in non forest area was around 41,7 million ha (Forestry Ministry, 2002), and it spread out in various types and functions of forest.

The loss of forest in Indonesia has risen sharply over the last 12 years. In the research done by Matt Hansen from University of Maryland, it was found that Indonesia lost 15,8 million hectares between 2000 and 2012. This showed that Indonesia was in the fifth rank of country which lost the forest after Russia, Brazil, United States, and Canada. However, of the five countries mentioned, based on the

percentage, Indonesia was in the first rank with the rate of forest loss of 8,4 %. As a comparison, Brazil only lost half of the proportion above (Matt Hansen , 2013).

Forestry Minister, Zulkifli Hasan, said that the rate of deforestation and forest degradation in Indonesia decreased very significantly. Between 1996-2003, it decreased 3,5 million hectares per year on the average. However, it becomes only 450 thousand hectares now. This statement was delivered to Tempo.CO, November 28, 2012 edition in commemoration of Indonesian Tree Planting Day and National Planting Month 2012 in the area of City Forest, Soekarno-Hatta International Airport in Tangerang (Anonymous , 2012) .

Whatever the facts conveyed above that there was either an increase or a decrease of degradation, forest in Indonesia has a changing-function phenomenon from forest land into farming, housing, business and tourism areas (establised areas) in watershed which takes place relatively quickly. It can damage the primary function of forest as a watershed.

The concept development of forest and water in Indonesia

Public perception and public policy on the protection of watershed want to have a condition (forest) in the upstream regions and associate each flood to the loss of forest cover in the hills and mountains. Therefore, timber planting is a benchmark in rehabilitation. 'Ecohydrology' approach involves more than one focuses of forest cover level in the watershed upstream. This is because the number, timing, and quality of water flows are determined by land cover and land use across the landscape. In Indonesia, it seems that the debate of public policy has not much changed yet since de Haan (1936) wrote the issue of forest protection:

> *"There was too much emphasis on the differences between forest and non-forest. People often assume that as long as a certain percentage of land is covered with protected forests, the agricultural actors outside the area can do anything they want. The truth cannot be denied. The difference of hydrological behaviour between a mountainous forest and rubber plantation, for example, is certainly smaller than the difference between the behavior of rubber plantation and farming land of a seasonal plant."*

Kartasubrata (1981), summarized the development of ideas about forests and water in Indonesia, such as the ideas which often took place in the debate during the colonial era. Since the debate still resonates to this day, it will become something interesting if we take a look at the arguments that emerged at that time. The debate developed to heat up because of Heringa statement (1939) which

required the closing of forests in Java to be significantly improved for the production of wood, resin, turpentine, tannin and as well as for the benefit of hydrology in forest. In Java Island with high volcanoes, the rivers decline steeply so that in the rainy season the water flows rapidly into the sea. The speed of the water flow generates such a large force that can carry a lot of fertile soil and silt from agricultural land and river cliff that deposit in the sea. Heringa put forward the theory that generated many debates when he said:

> *"Forest is like foam (sponge); it sucks water from the ground in the rainy season and releases it gradually during the dry season when there is a shortage of water. The decreasing of forest cover will lead to a reduced supply of water during the east season (' dry season ') so that it causes the shortage of water. Therefore, a balance is required between forest condition and output of agricultural land (paddy). Consequently, it must be determined a minimum percentage of forest for each water catchment area".*

Roessel (1939) welcomed the idea of the development of industrial forest plantations, but he criticized the use of hydrological argument to justify the reforestation. He put forward the theory that emphasized that the infiltration of water percolation through the bottom layer of the soil (subsoil) produced springs; not forest that produced water .

Coster (1938) who worked at the Forest Research Institute in Bogor expressed quantitative data and provided a synthesis that plant determined the replenishment of the foam , but most of the water is at the bottom layer of the soil, not merely in the forest.

In many of today's debates, the Coster's view (1938) which was more synthesis was that positive and the negative effect of the trees on the river flow has not been found out, and the public perception and policy direction thatexist now are much more on the Heringa's view. The concept that 'the garden hedge' can function as ' protected forests ' in terms of infiltration and hydrology has been still considered new at this point because the dichotomy between forest and non-forest land use is in the regulatory framework and public perception. At Chambery Declaration on forests and water in the context of the International Clean Water Year, 2003, it contained the statement that non -forest could not meet the watershed functions as what forests gave.

As explored by Grove (1995), the perception of the relationship of deforestation followed by changes in rainfall patterns, land degradation and siltation of river mud came from the experience in the Mediterranean area. Greek philosopher, Theophrastus, was a man who started writing the document sources of this perception. The European colonial expansion into the tropics, especially their experience in small islands like Mauritius reinforced the perception that forest evoked rain. The documented strong

evidence of the changes in rainfall patterns as the result of deforestation is almost non-existent, and the causal relationship of forest and rain (rain = > forest) generally occurs the opposite way (forest = > rain). The results of the most recent re-analysis of rainfall patterns for Indonesia (Kaimuddin , 2000; Rizaldi Boer , pers.com), indicated that the shifts in isohyets (zones with the same rain) in Indonesia were not clearly related to local land cover change: some areas that lost their forest cover became wetter, but other areas that lost forest cover became drier. Indonesia as a whole, the average rainfall does not change although there are many reductions of forest cover, but a change in global circulation pattern which affects the local rainfall pattern could possibly occur.

Although on a local scale, there are real changes in rainfall patterns related to the changes of forest cover, there is no convincing evidence to support the hypothesis of their causal relationship. The way how landscape processes the coming rain is highly dependent on land cover and rainfall amount. Flow regulation and river water quality are directly affected by the changes in cover.

The perception that has been widely recognized on the influence of forest cover in the watershed functions in the maintenance of water sources in recent decades has been questioned in the study of hydrology. The dichotomy of forest and non-forest has turned into a recognition that land use after forest use change can actually make a lot of difference. Land use (not limited to the protection of existing forest cover) in the area of water resources has a multi -party benefits for both local and external. Moreover, the increasing demand for water in the downstream often provokes conflict about what happens in the area of water resources. Watershed upstream in some tropical regions supports life for farm and rural communities that are outside the mainstream of development. As a result, there is a distinction of upstream and downstream with conflicts of interest; communities living in watershed upstream is considered as the destroyer of watershed function, therefore, there is no recognition and mechanism of rewarding for the system of their land use that actually protects water resources.

Criteria and indicators

Various important aspects of the river flow (annual water yield, stability of river flow, flood frequency on wetlands, alluvial plains, and other areas along the river, as well as the availability of water in the dry season) are determined by the level of rainfall on hydrological processes of watershed. In order to become more focused on the studying of watershed function, it is necessary to separate among the contributions of rain, terrain (area topographic form and the other geologic nature which are not directly affected by land use change), and the role of land cover (especially those directly affected by human activity). A set of criteria of

watershed function that can be measured is proposed in this paper. Based on the magnitude of river discharge, there is relatively much amount of rainfall. The criteria were focused on the watershed functions that are influenced by land use and land cover system, with different location characteristics from one place to another place. Location characteristics include the amount and pattern of precipitation which cannot be changed easily by human activity.

The criteria for these functions have different relevance for each multi- party in accordance with the interests and viewpoints respectively (Figure 2). The availability of quantitative indicators for various criteria is very necessary because it will help the negotiation process for a multi – party although these criteria may not be able to fulfill the desire of all parties in the watershed. The availability of quantitative indicators for various criteria is very necessary because it will help the negotiation process for a multi -party although these criteria may not be able to fulfill the desire of all parties in the watershed.

Land cover by the tree in all its forms can affect the flow of water. Tree cover may be either natural forest or natural regeneration of plants in the forest – the cultivated trees, the tree as a hedge plant, or monoculture tree (e.g. industrial plant forest). Tree cover affects the flow of water in various stages:

a. interception. During the rain, the tree canopy can absorb and store rain water in the form of a thin layer of water (waterfilm) on the surface of leaves and stems which then will evaporate before it hit the ground. The amount of water that can be absorbed and evaporated depends on leaf area index (LAI, leaf area index), the characteristics of the leaf surface, and rainfall characteristics. Interception is an important component if the amount of rainfall is low, but it can be ignored if the rainfall is high.
b. Protection of soil aggregates. The vegetation and pile of falling leaf layer protect the soil surface from the direct hit of raindrops that can destroy the soil aggregates resulting in soil compaction. The crushed soil particles can cause the clogging of soil macro pores so that they inhibit the infiltration of ground water that causes the surface of land increase. The role of falling leaf layer in protecting the soil surface is strongly influenced by its resistance to weathering; high quality of falling leaf layer having nutrients especially high N will easily become decayed so that the function of the ground closure does not last long.
c. Infiltration. The process of infiltration depends on the soil structure in the surface layer and various layers in the soil profile. The soil structure is also affected by the activities of biota that depend on the energy source of organic matter (falling leaf layer on the surface, organic exudation by the roots, and the dead roots). The availability

of food for biota (especially earthworms) is very important to anticipate the process of decay and soil macro-pore clogging.

d. Water uptake. Throughout the year, the plant absorbs water from different layers of the soil to support the process of transpiration on the leaf surface. Factors affected the amount of water uptake by trees are tree phenology, root distribution, and physiological responses to the stress the availability of water partial grip. Water uptake in each rainfall will affect the amount of water that can be stored in the soil to the next rainfall. Then it affects the process of infiltration and surface runoff . Water uptake in the dry season, especially from deeper soil layers will affect the amount of water available for 'slow flow.'

e. Drainage of landscape. The drainage amount of a landscape is influenced by several factors, such as soil surface roughness, soil surface relief that allows water to stay in the ground longer and encourage infiltration , type of channel formed as a result of runoff that can lead to "rapid flow of water land " (quick flow). In natural forest, crossing animals usually leave the path which becomes the first trigger the formation of surface flow paths although its level is still not too dangerous. The path that is the path of light and heavy vehicles during tree removing in the forest tends to increase the intensity of runoff and sediment into the river wash out. Land management after forest conversion is usually intended for drainage improvement in order to protect the plant from flooding hazard and/ or surface runoff.

On the contrary, if there is an effort to reduce the frequency of flooding in the upstream area by accelerating the flow from upstream to downstream, it will increase the risk of downstream flooding. It can be seen that the overall impact of the forest conversion and tree cover changes in the landscape can be recognized from the combination and interaction of the various process mentioned above. Several simulation models have been developed and can be used to test the closeness of the relationship of empirical data with the predicted result data. Models that already exist vary in spatial scale, temporal resolution and the input of required data. For example, the effect of agro-forestry systems on a daily runoff at the plot scale can be evaluated by using the model WaNuLCAS (Khasanah et al ., 2004). The impact of land use change on water balance daily on a scale of landscapes can be studied by using the GenRiver model (Farida and Van Noordwijk , 2004) and the Fallow model (Suyamto et al . , 2004) to predict the impact of land use change on annual water balance.

Protected Garden

Forest land classification system in Indonesia towards the number of 'forest function' includes conservation, watershed protection, timber and non-timber production. Existing rules on land use varies depending on the

primary function that is of the first importance. 'Protected forest ' has the meaning of active forest protection function towards the flow of water to downstream areas. In the Netherlands term 'protected forest' or 'schermbos ' means forest that serves as the 'umbrella' or 'shelter'.

The function of 'buffer' is actually directly related to the function of shelter' because this function can reduce peak discharge in the occurrence of rain. the buffer function can be improved by increasing the use of water and maintain the soil structure on the hills (hillslope). At the landscape scale, the flood buffer function can also be done by maintaining the swamp area that can be the reservoir of water overflow due to the flood.

The function of protection in the upstream region can actually be provided by the cover from various vegetation as long as the system is able to: (a) maintain the litter layer on the soil surface, (b) prevent the formation of grooves and gullies due to the erosion, (c) absorb the water for evapotranspiration. If the natural forest vegetaion is gradually replaced by trees with high economic value or have other functions, the function of 'shelter' should still be present.

The agricultural land clearing system weith the means of clear-cutting on a large scale will reduce the protective function. In the transformation, forests gradually become agro-forestry systems, no logging is done on a large scale so that in their regeneration process, the forest function can still be maintained.

In Indonesian concept, the word 'forest' means that the land whose ownership and management are supervised directly by the government or state. Whereas, the land which 'resembles forest' or agro-forest' owned by farmers is commonly called 'the garden'. On the garden system, the management is more focused on the two functions – production function protected function. In relation to the criteria and indicators of hydrology as described above, several kinds of gardens have been evaluated. The results indicated that the garden like a mixture coffee plantations; rubber forest; 'inter-space' that is a mixed system of fruit trees, timber trees and herbs in West Sumatra; yard fruit garden (mixed fruit tree home-gardens) and 'repong' system of resin is the system that is able to fulfill a variety of 'protected function' on the hills. Thus, the garden is appropriate to be called 'protected garden' because it can serve double functions 'production' and 'protected'.

Approximately, 70 % of Indonesia's total land area is classified as ' state forest ' or forest areas in which the decision over the access to land is taken at the national level (especially prior to 1998) and at provincial and district levels (after 1998). In many areas, the relationship between the local government and farmers is often not harmonious (regardless of the length of the farmers living in a local area). The conflict between the government and the beneficiaries of forest usually make things worse; to

the condition either the forest or the community. The advantage is often taken by those who perform logging legally or illegally.

Pasha et al. (2004) of a case study in Sumberjaya revealed that the recognition of the 'protected garden ', gave a great hope in reducing the conflict and at the same time promising improvement, both for tenant / land users and for the restoration of the forest.

The Function of Protected Garden in Forest Protection

1. Protected garden can recover the lost functions of forest after changing their use. However, it should be understood that not all the missing functions can be recovered through the application of protected garden, and produce the same function (both their kinds and their quality).
2. The community paraticipation in the management, security and maintenance of trees is maintained.
3. The protected garden shows the characteristics that is appropriately given attention in the development of agriculture and forestry, particularly in the areas that are ecologically sensitive (less fertile, too steep, too rocky).
4. The position of commercial tree plants and their economic value as the capital and inheritance can prevent the opening of new fields, thus protected gardens become free from the threat of other shifting cultivation.
5. Since 1960s, the model of forest management which was developed has been sticked to the timber production. Timber forest was the dominant element which was relatively difficult and took a long time to update. The exploitation was based on the stand not the individual tree which caused a drastic degradation of the entire forest ecosystem. This led to a proposal that the forestry parties in the broad sense payed more attention to non- timber forest products (also called minor forest products), for example resin, crumb rubber and latex, fruits, grains, fragrant woods, dyes, natural pesticides, and chemicals for the drug industry.
6. Establishing a protected garden is one of the important acts for the community around the forest to have forest resources back which is ever lost or forbidden for them. Protected gardens allow for the preservation of authority and responsibility of local communities over the whole forest resources.
7. The use-switching of forest land becoming an agricultural land has posed many problems, such as the decrease of soil fertility, erosion, extinction of flora and fauna, floods, droughts and even global environmental change.

CONCLUSION

The recognition towards the 'protected garden' can reduce current confict between the community and the government as long as the focus of watershed management can be directed to the restoration of the forest functions by using the measurable criteria and indicators, not only just based on the perception of the importance of land cover by forest vegetation.

Protected gardens have 7 important roles in forest protection because they have conservation function and economic functions from forest products besides wood. Moreover, they can empower the existing communities around the forest, and establishing protected garden is one of ways to rehabilitate forests that experience degradation now.

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