

REHABILITATION OF DEVASTATED PEAT LANDS AND ESTABLISHMENT OF SUSTAINABLE AGRO-SYSTEMS THROUGH BUFFER ZONE PLANNING IN CENTRAL KALIMANTAN

Mitsuru Osaki¹, ✉ Hanny Wijaya², Suwido Hester Limin³ and Herwint Simbolon⁴

¹Faculty of Agriculture, Hokkaido University, Sapporo, Japan;

²Faculty of Agricultural Technology, Bogor Agricultural University, Bogor;

³Faculty of Agriculture, The University of Palangka Raya, Palangka Raya;

⁴Herbarium Bogoriense-LIPI, Bogor.

Under the slogan of sustainable development, forests on the peat swamp and wetland area have been destroyed in tropical area. Needless to say, since it is very difficult to develop peat swamp and wetland, those huge areas still remain in natural or sub-natural conditions. Therefore, those areas have been considering as the key ecosystem for not only reserving bio resources and biodiversity, but also reducing carbon efflux owing to degradation of peat, stocking of carbon in forests, or controlling water balance. However, now, the peat swamp and wetland in tropical area face to the crisis of disappearance due to human impact, which is accelerated by recent abnormal and unusual global climate changes.

Peat swamp in Central Kalimantan are classified into three areas according to intensity of human activities, namely

- 1) The native peat swamp forest,
- 2) The destroyed, abandoned, and fire-damaged area, and
- 3) Highly continuous human activity (intensive agriculture) area.

Referring to these criteria in peat swamps in Central Kalimantan (surrounding Palangka Raya), the native peat swamp forest areas are located between Sebangau River and Katingan River (Sebangau-Katingan Watershed), the abandoned, destroyed, and fire-damaged areas are located between Sebangau River and Kahayan River (Sebangau-Kahayan Watershed), and intensive

agriculture areas are located between Kahayan River and Barito River (Kahayan-Barito Watershed).

It is proposed that agronomy group should focus on the protection of peat swamp. For this purpose, Sebangau-Kahayan Watershed is most suitable area because in Sebangau-Katingan Watershed, ecological group will be care there, and in Kahayan-Barito Watershed, peat for protection has already been disappeared. Since Sebangau-Kahayan Watershed is located between Sebangau-Katingan Watershed and Kahayan-Barito Watershed, Sebangau-Kahayan Watershed is defined as protection or defence area for native area against intensive agriculture area. Along with Sebangau-Kahayan watershed, three types of peat soils are located such as inland peat, transitional peat, and coastal peat. However, since agricultural activity of coastal peat is quite different to inland peat and transitional peat, at first this project starts to study in inland peat and transitional peat. Thus, the following area are proposed as research belt zones:

1. Belt Zone Kalampangan (inland peat area with sandy material sub layer) lies between both rivers of 10 km long, 5 km wide.
2. Belt Zone Pangkoh (transitional peat with clay material sub layer) lies between both rivers of 40 km long, 5 km wide.

Instead of sustainable development of peat swamp, it is proposed that' principal concept of this

project are 1) to conserve the native peat swamp forests (subject I, conservation area), 2) to rehabilitate and protect the destroyed, abandoned, and fire damaged area in surrounding area of native forest (subject II, protection area), and 3) to reduce the human impact to surrounding area, to minimize the introduction of civil engineering works, and to establish the sustainable production system (subject III, sustainable production area).

At first, to combine the three subjects, it is important to know the ecological properties on the succession or sequence of ecosystem in various sites from deep peat to shallow peat areas, including farmer field in where peat layer is very shallow or disappeared already, and is affected by acid sulphate soil and sandy podzolic soil. Therefore, following parameters should be measured along with the sequence of ecosystem in various sites from deep peat to shallow peat area: 1) carbon and nutrients cycle, 2) soil properties (emphasizing on the chemical properties and micro-organisms activity, decomposition of peat), 3) water and heat flux, 4) CH₄ emission, and 5) vegetation. Then for the subject II in protection area, it is required to study on 1) rehabilitation of dominant trees, 2) silviculture of useful trees such as timber, and medical or chemical substances produced-trees, and fire-protection trees. For the subject III in sustainable production area, agronomy-agroforestry system should be established, including the studies on water and soil management, plant cultivation methods, and introduction of specific plants such as 1) field crops for poor nutrients tolerant (nutrients use-efficient, low pH tolerant, Na tolerant), 2) fruit trees, 3) fibre crops (banana, bamboo, *Sclaria* spp., palms, *Pandanus* spp., etc.), 4) pastures, and 5) cover crops (kudzu, *Mucuna* etc.).

The lowland wetland area of Central Kalimantan shows extremely complicated and diversified ecological system. But with careful

observation, it can be pointed out that the area seems to have gradient in many criteria such as soil type and distribution, vegetation, hydrological condition, and the land use that is the reflection of history of human activity in this area. Obviously, this tropical wetland area is the one and the only of such an ecological system that can be found in the world.

Such gradient is most apparent to be observed along a transect passing through an area from the large river stream to the interior part of peat swamp forest. For instance, the lower reaches of the main river stream are highly affected by seawater, but the salinity declines with distance from the main stream. Soil distribution along the riverbank is mainly covered by alluvial soil forming a levee through deposition of silt contained in the river water. But, apart from the riverbank, the formation of peat soil is established where the thickness of peat increases toward the boundary of watershed. Prior to the development of the peat, however, the weathering, formation, and development processes of the underlying soil has long been occurring resulted in a sandy sub layer of the inland peat soils and marine clay sediment sub layer of the coastal peat soils. In some places, a pyritic sub layer in which an acid sulphate soil can be formed if the layer is oxidized accompanies the latter. As nutrient rich topogenous peat soils and the inland area, which is dominant in Central Kalimantan, occupy a resultant of all of these processes, the coastal and near river stream area occupied by relatively poorer nutrient containing ombrogenous peat soils.

The latitude of human activity also shows a gradient along the transect from the riverbank to the interior peat swamp forest. People first inhabited the bank of large river because of its accessibility and soil fertility reasons. They gradually moved toward inland through and by making anjirs and handils for logging and starting

permanently agricultural activities. Since then, population is growing and some more areas are needed as well. Nowadays, the frontier seems to move toward west direction, over going into the watershed of Sungai Kahayan and Sungai Sebangau that are still relatively covered with forest.

In the JSPS Core University Program entitled "Environmental Management of Wetlands Ecosystems in Southeast Asia", the agricultural sciences group declared its research concept as follows:

- (1) To conserve the native peat swamp forests (subject I, conservation area),
- (2) To rehabilitate and protect the destroyed, abandoned, and fire-damaged area in surrounding area of native forest (subject II, protection area), and
- (3) To reduce the human impact to surrounding area, to minimize the introduction of civil engineering works, and to establish the sustainable production (subject III, sustainable production area).

And from these points of view, it is requested to choose appropriate study area for this study.

It would be the best if the study area can cover the whole one watershed of relatively large river system and designate it as the research area, because such watershed seems to contain both extremely diversified ecosystem and agro system. However, to be realistic, it is quite difficult to set such large area as a research object because of implicated human activities that already established in the area, and also of difficulty in conserving the appropriate condition of research environments necessitated for the research study project.

By establishing the research area as belt zones connecting two large rivers, the Sungai Kahayan and the Sungai Sebangau, the above requirement of the research concept can be easily

satisfied. And, it is scientifically justified that these belt zones should cover both the coastal and the inland peat land area. Since some places of these areas have long been established and cultivated for various agricultural commodities and other activities with various degree of success, the belt zones should cover those inhabited areas.

Based on the above-mentioned Justifications, the following areas are proposed as research belt zones:

Belt Zone A

Covering an area lies between Sungai Kahayan and Sungai Sebangau of 10 km wide that passes through the formerly transmigration area Pangkoh, this belt zone is to represent the coastal peat land area with clay material sub layer.

Belt Zone B

Covering an area lies between Sungai Kahayan and Sungai Sebangau of 10 km wide that passes through the formerly transmigration area Kalamangan, this belt zone is to represent the inland peat area with sandy material sub layer.

Once these zones are established, meaning that the area is preserved and protected as a tropical peat land conservation area, the following phases of the research programs are proposed:

1. Phase I: The Baseline Study

Year 1 to 2

The results of this study will be used as a basic consideration in establishing the detail research programs and activities and their required experimental plots.

2. Phase II: The Implementation of the Detail Research Programs and Activities.

Year 3 to 7

During this phase, the detail research programs integrating all related aspects are implemented. The goal of this phase is to establish a management practice that results in a better land

functions and productivity as a sustainable ecological system of bio production in Central Kalimantan's peat lands. As a basic criterion, the management practice that will be chosen and established should results in a better prosperity of the people with minimum environment disturbances or even without any of them as far as possible. This will be achieved through a series of research activities that will be implemented based on a yearly basis of evaluation.

3. Phase III: The Implementation of the Action

Research Programs.

Year 8 to 10

In this phase, the land management and practices established in the Phase II will be applied and improved accordingly to the research program area in a kind of participatory programs involving all the stakeholders, including farmers, extension workers, government officers, experts, etc. Based on the results of this phase, the establishment of a regional, national, and international networking on Sustainability of Ecological System of Bio-production in Tropical Wetlands will be proposed.