PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM AND WORKSHOP ON TROPICAL PEATLAND YOGYAKARTA, 27-29 AUGUST 2007

CARBON-CLIMATE-HUMAN INTERACTIONS ON TROPICAL PEATLAND: CARBON POOLS, FIRE, MITIGATION, RESTORATION AND WISE USE

Editors

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"Carbon-Climate-Human Interactions - Carbon Pools, Fire, Mitigation, Restoration and Wise Use"

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CONTENTS

SOME EFFORTS FOR IMPROVING DEGRADED PEATLAND IN THE BERBAK DELTA, JAMBI, INDONESIA

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SUMMARY

Reclamation of peatland of Indonesia has been carried out during the last 35 years for rice production through transmigration projects. One of the transmigration areas is located in the Berbak Delta, Jambi Province, Sumatra. In the early years, those lands produced rice grain up to 5 tons/ha. However, because the soils have changed into acid sulfate soils production has decreased drastically to less than 1 ton/ha. This paper presents the results of some efforts to improve degraded peatland for rice cultivation in the rainy season and chili cultivation after rice harvesting through application of macro- and micronutrients as well as water management. In their home gardens, farmers are encouraged to plant *Aquilaria sp.* (gaharu) for long-term family income.

KEYWORDS*:* acid sulfate soils, *Aquilaria sp* (gaharu), rice cultivation, tropical peatland

INTRODUCTION

Efforts to renovate degraded peatland in Indonesia by the Government have been carried out through many projects. Amongst these projects were canal maintenance through deepening of primary and secondary canals and provision of production goods through provision of fertilizers, pesticides, soil tillage equipment, and credit.

One degraded peatland area is located in the Berbak Delta of Jambi Province where about 60,000 ha of the area has changed into acid sulfate soils. In the early stage of reclamation, rice production of the land reached 5 tons/ha, but gradually decreased thereafter to a production of less then 1 ton/ha. Nowadays some farmers are still continuing rice cultivation with low production, while some others have abandoned their lands.

Most of scientific suggestions say that there are several reasons for the unsuccessful renovation of acid sulfate soil including extreme acidity of soil and water, extreme soil drying in the dry season, and prolonged flooding in the rainy season. Our field observations, however, strongly suggested that there is still a possibility to make renovation of the agricultural land in order to create various incomes for the farmers. Farmers have enough time to generate income from other activities in addition to cultivating rice as their main income, such as planting vegetable crops after rice and planting high economic value plants in their home gardens. Chili is one recommended vegetables for these areas because it attracts a relatively good price. Gaharu (*Aquilaria sp*) was selected for long term income generation and it can be planted in their home gardens.

This paper discusses mainly our experiences in implementing rice and chili cultivation as well as gaharu planting in home gardens on abandoned acid sulfate soils in Rantau Rasau District in Berbak Delta, Jambi Province.

LOCATION OF RICE, CHILI AND GAHARU CULTIVATION

Rice cultivation was carried out on 100 hectares of farmer lands in Rantau Makmur village (Figure 1) from August 2005 to March 2006 involving 60 families. Each family cultivated either 1.0, 1.5, or 2.0 hectares depended on the size of the land they owned and the availability of workers. The implementation of rice cultivation was carried out in collaboration with Jambi Provincial Government.

Some farmers out of the 60 families cultivated chili in the dry season after the rice planting period in Rantau Makmur village. The size of the chili cultivation plots of each farmer varied depending on availability of capital and workers.

The cultivation of *Aquilaria sp* involved 500 farmers in the 3 villages of Rantau Rasau II, Bandar Jaya, and Rasau Jaya. The planting of Gaharu was done in collaboration with NPO MOYAI Network JAPAN, the National Land Afforestation Promotion Organization.

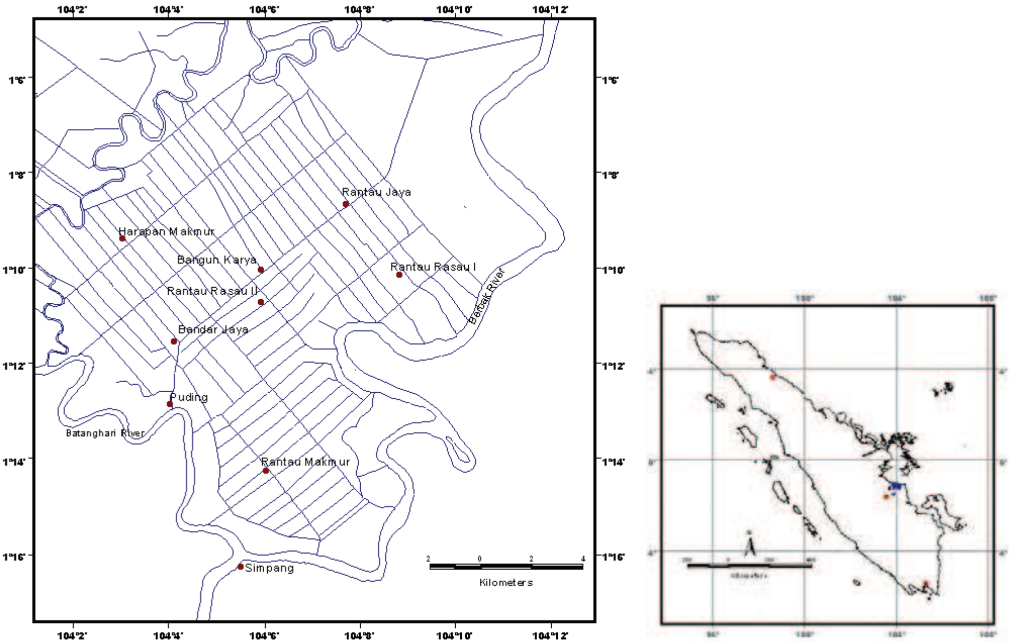

Figure 1 Location of the study area in Rantau Makmur village

RESULTS AND DISCUSSION

Soil properties

Before reclamation the area was a peat swamp forest with a thin layer of peat (< 50 cm depth). This peat layer was underlain by mangrove mud containing a high amount of pyrite mineral. After years of reclamation and utilization, the peat layer has almost disappeared leaving a peaty clay layer 0 to 20 cm at the surface.

Soil analysis using method from Sparks *et al.* (1996) shows that the mangrove mud sediment in this area developed from materials transported from higher regions, which are mainly composed of acidic rocks with relatively low Fe_2O_3 content. Sample analyses show that the sediment is rich in sulphur and very low in Fe_2O_3. Pyrite content (represented by S content) in the top layer (0-40 cm) was very low at only about 0.6% compared to a much higher content in the sub surface layer that contains up to more than 2%. Like the S content, the content of Fe_2O_3 in the top layer was much lower than that in the subsurface layer. These data confirmed that most of the pyrite in the top layer has been oxidized. Soil chemical characteristics of the oxidized layer are presented in Table 1. The table shows that at depth of 0-5 cm, the soil was characterized by very low pH (4.2), low content of exchangeable bases, and very high exchangeable Al (16 meq/100g).

Table 1 Soil characteristics of rice fields in Rantau Makmur

Depth (cm)	pH H_2O	Exchangeable bases (meq/100g)				Exch. Al (meq/100g)	CEC (meq/100)	Base sat (%)
		Ca	Mg	K	Na			
0-5	4.19	1.11	3.09	0.08	0.13	15.6	59.98	7.35
5-9	4.90	1.04	2.75	0.08	0.13	16.8	69.81	5.72
9-15	4.13	0.92	1.92	0.10	0.15	13.4	70.80	4.36
15-20	4.21	0.81	1.99	0.07	0.12	12.7	71.78	4.18
20-25	4.22	0.91	2.38	0.08	0.11	16.9	60.28	5.78
25-30	4.30	0.82	2.06	0.08	0.11	17.3	60.96	5.03
30-35	4.29	0.86	1.80	0.09	0.11	14.7	49.16	5.80
35-40	4.23	0.82	1.94	0.10	0.13	16.2	54.08	5.53

Rice Growth and Production

In the early stage, rice growth showed a good performance except in locations close to canal reconstruction. In general, at the following stage rice plant growth was not good, indicated by yellowish leaf color; and weeds grew in almost all of the fields. There was also damage to the rice plants as a result of attack by birds, wild boars and rats.

Three rice varieties were planted in the study areas (Table 2). The certified IR-42 occupied about 75.3 ha, certified Batanghari occupied 10.5 ha and Semut, a local variety, occupied (5.8 ha). This proportion was not planned but was determined by the amounts of both certified varieties IR-42 and Batanghari provided by the local government. Farmers themselves provided the Semut variety to make up for the lack of the two certified seed varieties.

Figure 2 Land was abandoned after more than 15 years of rice cultivation; this trial has again yielded up to 5 tons/ha, by applying water management and appropriate technology. Cultivation of chili after rice harvesting also shows a promising result.

Table 2 Dry rice grain production in the 100 ha pilot project.

Rice variety	Planting area (ha)	Average rice Production (ton/ha)
IR-42	75.3	3.5
Batanghari	10.5	3.1
Semut	5.8	2.7

The highest average rice yield was obtained for IR-42 (3.5 ton/ha) and the lowest was obtained for Semut (2.7 ton/ha). A relatively good yield of IR-42 and Batanghari varieties were obtained because there was no flooding during the rice growth period, as the rainy season of that year was late. Usually, the first rain falls in September, but in 2005 the rain was still rare until October-November and therefore the big flooding expected in December 2005 and January 2006 did not occur. Thus, the rain pattern in 2005/06, fortunately, was suitable for IR-42 and Batanghari varieties, but rice production of these varieties cannot be used as a reference for the next planting in the same season (Suwardi, *et al*., 2006).

The Semut production of only 2.7 ton/ha was lower than our result in the same location but in a smaller plot in 2004/05 that reached 4-5 ton/ha. The lower production can be explained by several reasons. Most of the Semut variety was planted in plots of secondary canal having stronger acidity due to nearer to Batanghari River so they have been more affected by high pH of water from the river. In general, rice production of plots in SC-5 was lower than SC-6, and SC-7. Moreover, most of IR-42 and Batanghari plots in SC-5 performed worse than Semut. The other factors that probably contributed to low rice production were late rice transplanting and poor land preparation.

Chili Cultivation.

After rice harvesting farmers have enough time to undertake other activities to increase their income generation. Some farmers have started to cultivate chili in part of their land after growing rice (Figure 2). They chose chili because it is relatively easy to cultivate and it fetches quite a high price. Farmers usually obtain more money from cultivation of chili than from rice production. Obstacles to chili cultivation are a lack of capital and labour. Chili cultivation requires quite a high level of investment to purchase seed, organic and chemical fertilizers and pesticides but also for intensive land preparation and maintenance. Endowment of capital and carrying out cultivation in a co-operative system are possible to improve and enlarge the chili cultivation area.

Because of labour and financial constraints, one farmer can optimally cultivate chili on only 0.25 ha of land. With good practices, however, the area of 0.25 ha could produce up to 2 tonnes of chili with a marketable value of 8 million Rupiah. Half of the income will be reinvested as capital.

Gaharu Planting in Farmer Gardens.

Gaharu is a non timber forest product, which has high economic value because it has many uses but especially for religious rituals. Gaharu (*Aquilaria sp*) is a woody perennial plant having high economic value for the gaharu resin it produces. This resin produces a good-smell when burnt. Not all gaharu plants grown in the forest produce gaharu resin; it depends on infection of a certain fungus. There is a specific technique for inoculating the fungi into the gaharu plant to obtain the best result.

Up to now, gaharu was mostly collected by people from natural plants inside wet tropical forest but this continuous extraction has caused the availability of gaharu to decrease drastically. Meanwhile, demand for the resin from countries in Asia and the Middle East, such as Japan, India, China, Saudi Arabia, has increased. Therefore, it is very important to produce gaharu resin by cultivating *Aquilaria* trees in order to supply this demand.

Regarding the benefit of gaharu plantations and considering the environmental suitability of this study area for gaharu plantation, we have tried to collaborate with farmers to cultivate gaharu in their home gardens. Small gaharu seedlings were obtained from Sarolangun, Jambi in March 2nd, 2005 and were grown with care for 6 months under paranet cover (Figure 3). After the seedlings reached about 50 cm height, and were strong enough, they were distributed to the farmers who transplanted them into their home gardens. Seven thousand gaharu seedlings have been distributed to more than 500 people in the study area. Each farmer received 10-20 gaharu seedlings depending on the size of their home garden (Suwardi *et al.,* 2005).

Figure 3 Aquilaria seedlings and after 2 years transplanting in home garden.

Farmers who received gaharu seedlings are obligated to plant and to maintain the plants in their home gardens. After 8 months, most of the gaharu plants grew well while some others showed abnormal symptoms and some died. About 5% of gaharu plants died as a result of drought, pests and disease. At this age, the height of plants ranged from 70-120 cm with stem diameters of 1-3 cm. In July 2007, 2 years after transplanting, the height ranged from 150-300 cm with stem diameters of 4-7 cm (Figure 3). The growth quality of the plants seems to depend on soil fertility and the level of maintenance given to them by the farmers. The plants, which were planted within holes containing organic matter, generally grew well. In contrast, plants that were planted without addition of compost, generally showing abnormal symptoms characterized by yellowish plant leaves and small height.

By growing gaharu plant in their home gardens, in the long run, farmers have opportunity to earn much money. However, this chance will become a reality only if farmers can maintain their gaharu plants and be successful in inoculating the fungus. With the success of cultivation of gaharu plants in home gardens, Indonesia could again become a gaharu exporting country.

Agricultural activities for utilizing acid sulfate soil should be synchronized with the soil, plant and climate characteristics. In the early rainy season when water is much more available and the pH of soil is still low, farmers can cultivate rice. Good yields can be achieved by improvement of water management, foliar application of fertilizer, and planting local varieties. During the dry season that comes after rice harvesting, cultivation of a high economic value crop, such as chili, is a good addition to livelihood. Chili is suitable to be planted in the low precipitation season when water is still available. The other opportunity for people of this studied area to get more income is by utilizing their home gardens for planting valuable plants. Gaharu cultivation is one opportunity for long-term income. Other activities such as animal husbandry and fishery could also be promising choices for farmers on acid sulfate soil areas

CONCLUSIONS

1. The main keys for successful of rice cultivation on acid sulfate soils are water management for irrigation and to flush away the toxic materials such as Al and maintenance of a relatively high pH of about 5 by liming. The use of local rice varieties such as Semut and application of micro- and macronutrients through foliar application are other keys to increase rice production.
2. After rice harvesting, cultivation of chili on acid sulfate soils of Rantau Makmur is highly recommended as it is seasonally suitable and brings a high price.
3. Gaharu is suitable for home gardens having a high income generating potential in the long run when farmers are successful in maintaining the plants to ensure they grow and by applying the correct technique to inoculate the plants with the fungus.

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