Review of the participatory forest fire prevention programmes in Jambi and West Kalimantan, Indonesia

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Abstract

The participatory forest fire prevention programmes of the Forest Fire Prevention Management Project (FFPMP) have been implemented with farmer groups using different models in Jambi and West Kalimantan. Both programmes aim at intensive fuel load management and fire control by cultivating green belts on community land around the forests and promoting permanent agriculture. The FFPMP will follow up with monitoring and technical assistance during the proposed second phase to increase farmers' participation in its fire prevention programmes.

At the Jambi site, the integrated green belt (IGB) incorporates a wire fence, a ditch, rows of various tree species and inner agricultural land. Farmers fenced approximately 15 km of the area and dug a ditch 9 km in length. Tree rows reached more than 10 km in length and 5-30 m in width. Perennial crops such as areca nut, albizia, rambutan, durian, citrus and coconut were planted. Wire fences were effective to keep out wild boars, boost productivity and reduce fuel loads on their fenced land. However, the farmers' knowledge of seedling production, land preparation without burning, crop planting and protection are limited. Alternative fencing technologies to replace the costly wire fences have to be considered.

At the West Kalimantan site, alley cropping or sloping agricultural land technology (SALT) is tested with nitrogen-fixing trees (NFTs), other trees and annual crops. A small number of farmers planted alleys and hedgerows with NFTs, but could not weed and prune according to schedule due to labour shortages.

1. Introduction

The Forest Fire Prevention Management Project (FFPMP) has initiated participatory programmes in Jambi and West Kalimantan Provinces, Indonesia. The programmes aim to achieve long-term forest fire prevention based on local communities' active participation in planning, implementation and evaluation. Most of the wildfires are caused by human activities in and around forests.

This paper reviews the implementation of the participatory programmes, outputs and constraints, and offers recommendations for future fire prevention activities.

2. Jambi site

2.1. Site condition

A pilot programme for community-based forest fire prevention is implemented at Rantau Rasau Desa and Sungai Rambut Villages, Rantau Rasau Sub-district, Tanjung Jabung District, Jambi Province (Figure 1). Both villages are situated along the boundary of Berbak National Park that protects one of the most important lowland swamp forests in Indonesia. Inhabitants consist of local Malay migrants (mainly at Sungai Rambut), and Javanese and Buginese migrants (mainly at Rantau Rasau Desa). The riverside has been settled mainly by the Malays since the end of the nineteenth century, and the inland by the Javanese and Buginese since the 1960s. The settlements are well organized with canals and ditches in most areas, divided into administrative units called neighbourhood associations (rukun tetangga - RT).

By and large, the Malay live on rice farming and freshwater fisheries, while the other ethnic groups depend on subsistence and cash crop agriculture. Many people have exploited the forests for timber, fish and wildlife to supplement their incomes. An elementary school was built, but public

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utilities, such as water supply, electricity, telephone and gas are still unavailable. The government has provided credit to both communities through its Presidential Funds for Under-developed Villages programme.

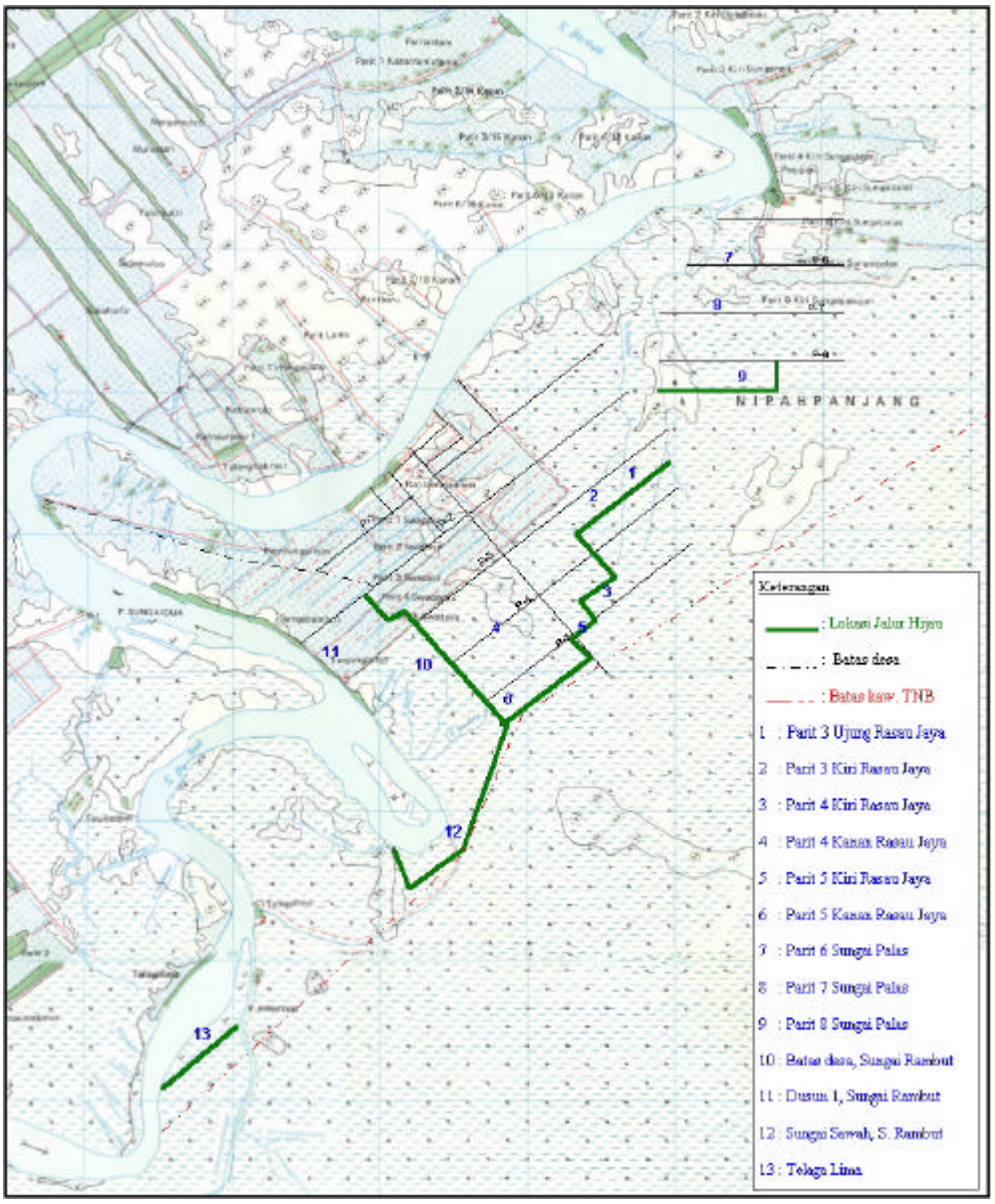

Figure 1: Project site in Jambi

2.2. Concept of participatory Integrated Green Belt

The integrated green belt (IGB) aims to protect the forests of the national parks from wildfires and agricultural land from wild boars by encouraging farmers to intensify land management. The IGB is established along the boundaries of existing agricultural fields close to the park boundaries with farmers' participation. The IGB basically consists of a wire fence, a ditch, tree rows and agricultural land (Figure 2). The wire fence is effective in keeping out wild boars, while the ditch stops ground fires and secures water for initial fire suppression. Tree rows are expected to control surface fires and obstruct the passage of wild boars, besides increasing agricultural productivity.

Suitable tree species need to be selected for effective fire prevention in terms of fuel load control and fire resistance, and to provide farmers with non-timber products. The selected species should grow easily on the wet and peat soils. Therefore, in the initial green belt design, the FFPMP restricted tree species selection to two criteria, i.e. for fire prevention and easy growth. Through community consultations, three of the farmers' preferred species that met the project's initial needs were selected – areca nut (*Areca catechu L.*), albizia (*Paraserianthes falcataria*) and lamtoro (*Leucaena leucocephala*). Areca nut is planted along the wire fence for support after existing wooden props have decayed. Albizia yields valuable timber in a short period while effectively forming hedgerows. Lamtoro is preferred by some farmers for its multipurpose functions, including soil improvement and fodder production.

At the second stage, other promising species, based on farmers' requests and report recommendations, were tested for their effectiveness in preventing fire. Fruit trees and multipurpose tree species (MPTS) were planted inside the fence, such as durian (*Durio zibethinus*), rambutan (*Nephelium lappaceum*) and melinjo (*Gnetum gnemon*). On the farmers' own initiative, demonstration plots were established to test these new tree crops within the fenced community land. The green belt is being expanded at both sides of the fence with the selected tree species.

The fire resistance of these tree crops needs to be tested during the trials. The farmers noticed that the bark of the trunk of the areca nut is thick enough to help the tree withstand fire. The long branches of the albizia can effectively inhibit the growth of ground cover, outweighing the vulnerability of its trunks to fires. Lamtoro is quite similar to albizia, but its trunk is more resistant to fire. Durian, rambutan and melinjo are generally resistant to fire because of their long branches and high moisture content in their trunks.

The immediate benefit of the IGB is its effective protection of community land and forest from wildfires. However, the farmers also expect the IGB to reduce inflammable undergrowth and enable the cultivation of annual and perennial crops. The FFPMP provides materials and encourages farmers to participate actively in green-belt activities.

During the course of the project, the farmers found that it was difficult to adhere to the original concept of planting in rigid lines to align the green belt with the fence. In response, the programme was modified and farmers were encouraged to cultivate according to topography and soil conditions (Figure 3).

2.3. Inputs for the establishment of the IGB

To motivate farmers to participate in the FFPMP, a number of incentives were provided. The FFPMP procured wire netting and some props, which the farmers used to construct fences in the designated areas. In total, 16.1 ton, or 15.3 km, of wire netting and 7,480 props were required (Table 1). The total cost of the wire fence amounted to approximately Rp9,000 per metre. More wire and props were needed at Sungai Rambut because of the inexperience of the local farmers in constructing wire fences. Migrant farmers extended the existing 4 km ditch at Rantau Rasau themselves, but some farmers at Sungai Rambut requested hired help because they were untrained in such construction work. In total, a 9 km ditch was dug (Table 1).

The FFPMP also distributed seedlings (half of which were purchased in Jambi) to participating farmers to speed up the establishment of the IGB (Tables 2 and 3). The cost of providing the seedlings was about Rp1,600 per tree. Areca nut (38 percent) was the farmers' most preferred tree species, followed by coconut (11 percent), rubber (7 percent), albizia (7 percent), citrus (6 percent), melinjo (4 percent), rambutan (3 percent) and durian (2 percent). Areca nut was most popular because of its ability to yield higher profits, easier cultivation even on wet soils, and good fire resistance. Coconut and rubber are common commercial crops at the site. Although they are vulnerable to fire, the farmers are expected to protect them from fire. Albizia is a lucrative source of timber and firewood. Some farmers are fond of citrus and other fruit trees even though they require special care.

Initially, the FFPMP produced seedlings of areca nut, albizia and lamtoro at a nursery in each village. However, the farmers were unable to manage the nurseries and skilled labourers had to be hired. The FFPMP has also supplied construction materials for a base camp and tower, and fertilizers for fruit trees and other tree crops.

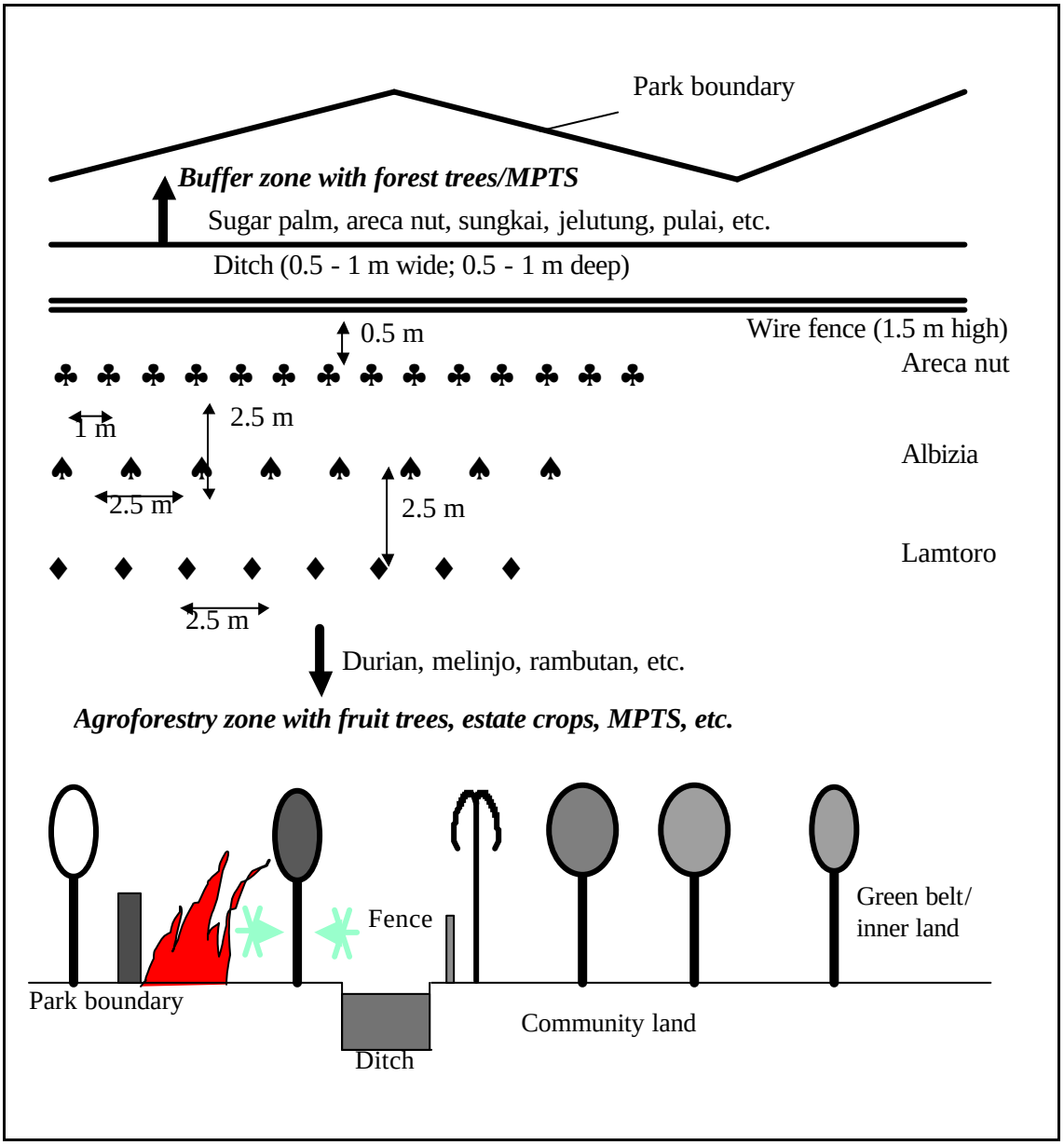

Figure 2: Model of the IGB

Table 1: Materials provided by FFPMP for wire fences and ditches

Village	Wire (t)	Prop (pieces)	Wire fence (km)	Ditch (km)
Rantau Rasau	10.2	5,150	11.9	6.6 (2.0)*
Sungai Rambut	5.9	2,330	3.4	2.4 (1.4)
Total	16.1	7,480	15.3	9.0 (5.6)

* Figures in brackets denote distance dug by paid labourers.

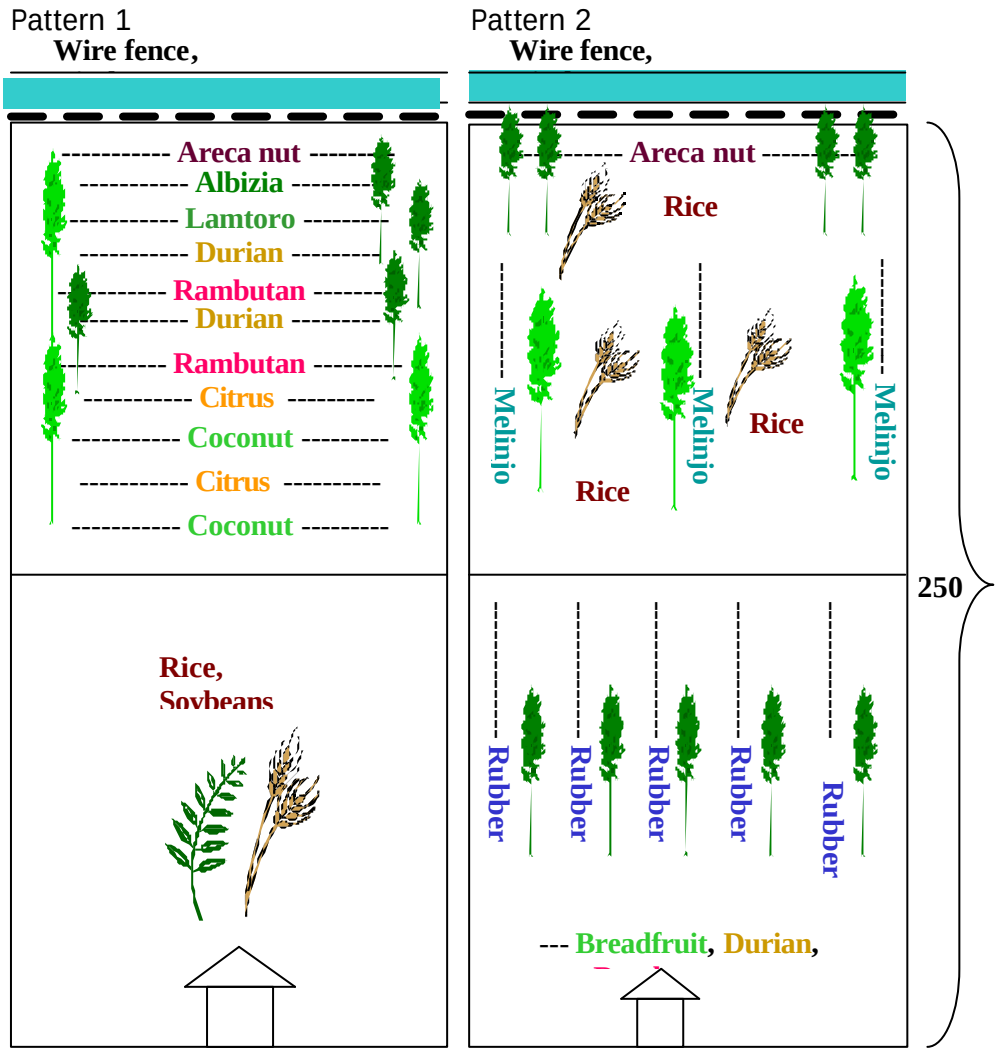

Figure 3: Modification of planting patterns of the IGB

Table 2: Number of seedlings provided by FFPMP

Village	1997	1998	1999	2000	Total
R. Rasau	8,711	56,691	20,303	44,098	129,803
S. Rambut	2,989	49,369	13,018	19,149	84,525
Total	11,700	106,060	33,321	63,247	214,328
Target area (ha)	15	72	50	88	225

Table 3: Number of seedlings produced by the nursery and provided by FFPMP

Village	Production	Provision
Rantau Rasau	61,000	53,000
Sungai Rambut	54,000	46,000
Total	115,000	109,000

2.4. Outputs of green belt activities

Up to now, 336 farmers were encouraged to participate in the green belt activities in Jambi. They were divided into 10 groups consisting of a total of 216 farmers at Rantau Rasau and 4 groups of 120 farmers at Sungai Rambut. Tree rows reached more than 10 km in length and 5-30 m in width by line-planting along the fence and broader planting on the higher elevations inside the fence. The survival rate ranged from 50 to 80 percent.

There were four different planting patterns (Figure 4). The first pattern is most common and planted with areca nut, durian, rambutan, citrus, coconut and other tree crops. Tree spacing is dependent on each species, but the land will ultimately be converted into tree gardens. Rice and other food crops are intercropped with trees. The second pattern is similar, but species composition is simpler, mainly with coconut, melinjo and food crops. Rice is still an important component. The third pattern maintains rice fields on the inner area, accompanied by some tree crops (e.g. areca nut, rubber, albizia, coconut) along the fence and on the homestead. In the fourth pattern, farmers cultivate only part of the land around their homesteads, while the more distant land along the fence is left untouched and covered with undergrowth.

It is assumed that the first and second patterns are more effective in preventing fire because of the farmers' careful cultivation of the whole land, while the wild vegetation of the fourth pattern harbours a greater fire risk. The success of the third pattern depends on the intensity of land management and fire behaviour.

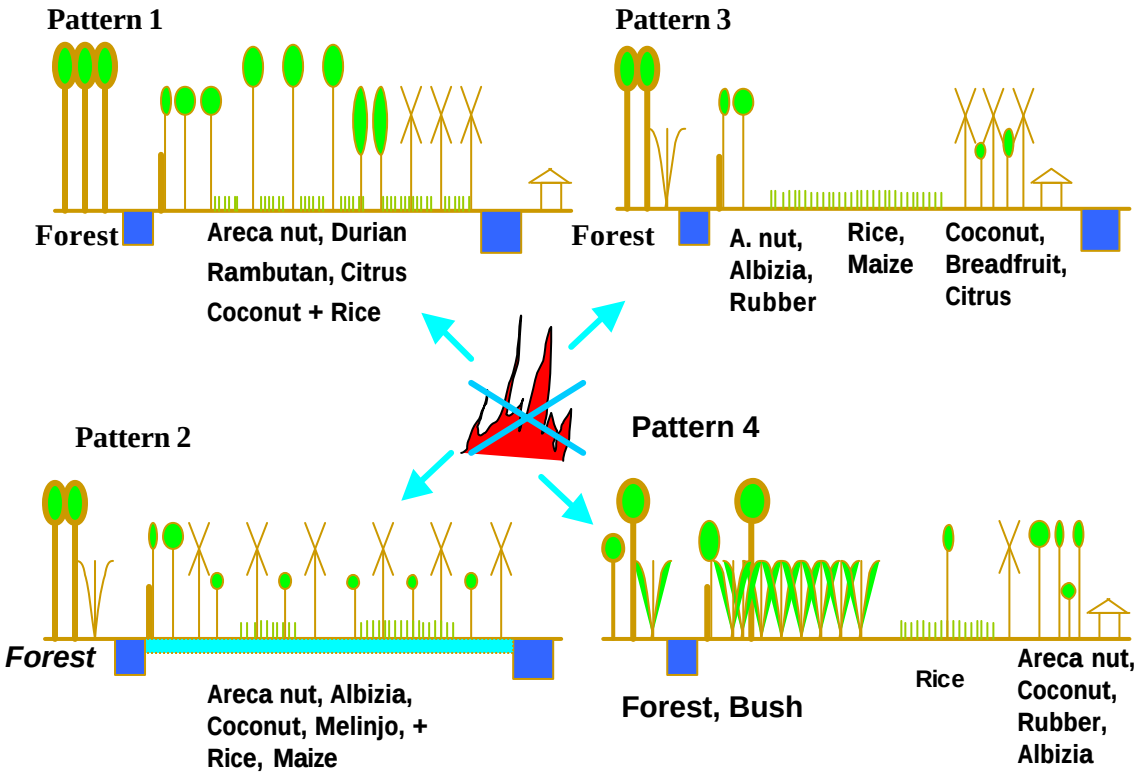

Figure 4: Planting patterns in the IGB

Major impacts of the IGB have been a decrease of wild boar damage (from 28.6 times per month in 1995 to 15.0 times per month in 1999) and a reduction in the use of fire for clearing land. However, more farmers resorted to herbicides for the land preparation and weeding (Table 4). Alternative land management technologies have to be sought to avoid their heavy reliance on herbicides. However, the farmers' capabilities in land improvement and crop protection (e.g. mounding, terracing, manual weeding and fertilization) are seriously limited.

Many farmers search for alternative employment. Their land is left fallow and overgrown with weeds, which often impede the growth of newly planted trees. Moreover, frequent flooding, caused by accelerating deforestation in upland areas and illegal logging in the vicinity, has severely damaged the tree crops. The farmers have noted the presence of acid water and soils in flooded areas.

Despite the farmers' growing interest in tree crops labour shortage and environmental factors have affected the growth of the tree crops.

Table 4: Changes in land preparation practices

Land preparation practices	1995		1999	
	Farmers (%)	Frequency/year	Farmers (%)	Frequency/year
Burning	8	13	0	0
Herbicides	45	85	73	135

Basic structure of the IGB

Areca nut

Extension of the IGB

Transport of seedlings

Examples of green belt establishment in Jambi

3. West Kalimantan site

The participatory fire prevention programme at the West Kalimantan site applies alley cropping or sloping agricultural land technology (SALT) to establish permanent farming systems on shifting cultivation areas. It is also implementing long-term fire prevention and control, which are new concepts to the pilot site and other parts of Kalimantan.

3.1. Site condition

The pilot site is located in a hilly area adjacent to a protection forest at Landau Beringin Sub-village, Nanga Pintas Village, Nanga Pinoh Sub-district, Sintang District in West Kalimantan Province. The inhabitants are local Dayak who have close community bonds, although modern cash economy is gradually penetrating the area. Shifting cultivation with short bush-fallow rotations (3-7 years) is still a common practice. The vegetation is burned, and the land planted with upland rice, with maize, peanuts and other food crops. After the rice harvest, the land is fallowed to allow growth of new vegetation. Cultivating degraded fallow land is difficult where only *Imperata* spp. can grow. Consequently, more farmers have started to encroach on protection forests for crop production.

In recent years, farmers have become more interested in permanent farming around their settlements to provide a more stable environment for the family, and enable their children to go to school. Some community members participate in government-sponsored semi-irrigated rice farming on the lower floodplains. Although trials indicated that double cropping of rice is possible, experiments are still at an early stage. There is still a great demand for improved dryland farming to raise crop yields and overcome resource degradation from short-fallow shifting cultivation.

3.2. Green belt model in West Kalimantan

The green belt in this site is modelled after SALT or contour cropping of nitrogen-fixing tree species (NFTs) (Figure 5). Hedgerows of leguminous shrubs are established at intervals of 4-5 m along contour lines on the sloping land. The most promising species are kemelandingan (*Leucaena leucocephala*), gamal (*Gliricidia sepium*), turi (*Sesbania grandiflora*) and *Flemingia congesta*. Gamal has been observed to be resistant to fires in the plantations of Perum Perhutani (State Forest Corporation) in Central Java. Kemelandingan may be less fire-resistant and more susceptible to psyllid pests. The spacing of the shrubs should be about 25 cm to form live fences for soil improvement. Taller NFTs are introduced to the surrounding dryland, such as calliandra (*Calliandra calothyrsus*), lamtoro merah (*Acacia villosa*), johar (*Cassia siamea*) and secang (*Caesalpinia sappan*), together with MPTS such as candlenut (*Aleurites moluccana*) under various planting arrangements.

The FFPMP decided to introduce a wide variety of tree species to reduce the risk of failure. Farmers are encouraged to grow upland rice and secondary food crops (*palawija*) continuously between the hedgerows of NFTs. Several cover crops can be planted on the fallow land after the harvest to restore soil fertility and limit growth of inflammable vegetation.

NFTs can be easily propagated from seeds. They can survive in poor-quality soil without fertilizers, but require pruning after the first year to reduce the negative effect of shading on agricultural crops. Farmers are requested to prune older plants up to 25-50 cm in height and mulch the alleys to control soil erosion and provide organic matter to the soil. NFTs capable of providing firewood and fodder are favoured.

3.3. Inputs by the project

Eight species of NFTs and some cover crops were distributed by the FFPMP to the participating farmers. The farmers also received 3,800 tree seedlings as an initial incentive for participation, including areca nut, banana and rubber, together with food crops such as soybeans, peanuts, corn and ginger. At the nursery, about 138,000 seedlings of calliandra, kemelandingan, gamal, turi and johar were produced to replace dead trees on the pilot dryland. Some farming tools were made available, including shears and saws, to ease pruning at the initial stage. The FFPMP also constructed a community hall – managed by the community – as a base camp for consultations and fieldwork.

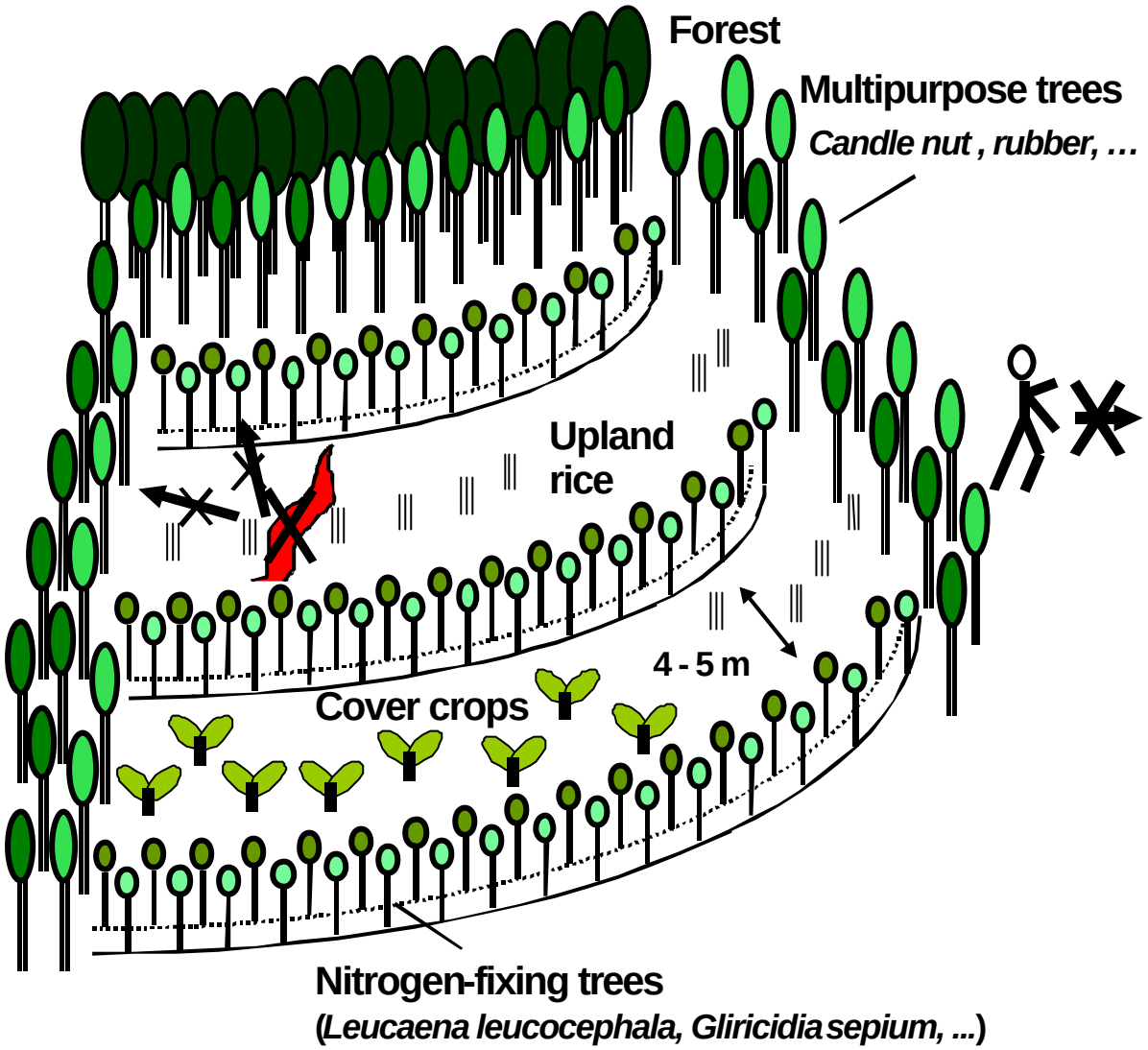

Figure 5: Green belt model for West Kalimantan site

3.4. Outputs: orientation and progress

Prior to implementation of the programme, project staff distributed technical manuals on alley cropping to government staff, local leaders and others. After conducting planting trials of NFTs around the site, the FFPMP helped to prepare the land and sow NFT seeds on selected plots located on sloping land along the village road to facilitate crop management and enhance the demonstration effect. By October 1999, two plots of approximately 7.5 ha had been planted with kemelandingan, gamal and turi in 26 hedgerows, amounting to 1.9 km in length.

Eleven out of 82 households participated in the initial stage. Community leaders assisted and supervised the daily activities, supported by regular technical assistance in cropping technologies from the FFPMP. Using the "A-frame" – a simple field instrument to lay out contour lines – farmers made holes about 25 cm apart and 4-5 cm deep along the contours, and put 4 or 5 seeds of a predetermined species into each hole.

Three of the farmers have developed more than 30 rows (2,200 m) in three pilot plots (9 ha) in one block, planted with kemelandingan, gamal, *Flemingia*, johar, calliandra, turi and lamtoro merah. Johar, calliandra and turi were highly resistant to weeds during their early stages of growth and grew very well, whereas kemelandingan and gamal did poorly because they suffer more from weed competition.

These farmers replanted over 10,000 seedlings and sowed 15 kg of alternative seeds on their land. The NFTs should have been pruned before they reached 3 m in height. However, pruning was delayed due to labour shortages. The alleys should be weeded before pruning the NFTs for effective mulching, which is also time consuming. Initially, the FFPMP provided farmers with food crops as an incentive to carry out the weeding.

Alley with *Cassia siamea*

4. Conclusions and recommendations

At the Jambi site, farmers actively participated in IGB activities hoping to prevent fires on their land and forest in the long term. Despite witnessing the advantages and benefits of IGB, the farmers are still unable to adopt IGB's land management and crop protection strategies because of a shortage of financial resources. Small-scale farmers or forest product gatherers cannot afford the lengthy wait for benefits to materialize. Long-term forest fire prevention through afforestation was a primary objective of the FFPMP, while the farmers expected quick cash returns or other financial incentives from participating in the project. The FFPMP tried to balance both needs through the IGP programme. However, there is still a gap between the short-term needs of the farmers and the long-term objective of the project.

Participatory forestry is expected to achieve successful afforestation and rural development. Still, farmers frequently participate in project activities only if direct incentives are provided because of the high labour inputs and long gestation periods. In addition, the farmers' living conditions, land-use systems and limited capacities are often overlooked during project planning.

To increase adoption rates of sound and effective firebreaks on community land, approaches will have to become more flexible and incorporate more bottom-up and self-reliant planning. Other economic activities that capitalize on the farmers' experiences should also be integrated (e.g. agriculture, fisheries and other land-related occupation). However, low-input technologies, particularly for land preparation and crop protection, must be pursued to sustain these activities. Alternative fencing methods (e.g. hedgerows with fast-growing trees) are essential to replace the costly wire fences.

Resource gatherers may be more agreeable to tree planting and forest restoration, but communities are not allowed to utilize park forests for personal uses because park authorities are concerned about further forest degradation. Agroforestry systems can be developed for agricultural lands if appropriate technical assistance, particularly for seedling production and tree protection, is provided to participating farmers. To ensure success of the programme, farmers have to be better organized, and ethnic and gender issues should receive more attention.

In the West Kalimantan site, the new alley-cropping trial has high potential for long-term fire prevention and permanent agriculture, but continuous support is still needed to improve the activities. Recommendations for future implementation include the following:

- Schedule and carry out land preparation, NFT sowing, weeding and pruning, properly to ensure optimal growth of NFTs.
- Ensure steady supplies of NFT seeds or seedlings within the village by allowing some of the trees to mature.
- Regulate alleys and land uses for effective soil protection.
- Promote the programme to other farmers through the experience and success of pioneer farmers.

Field staff and facilitators are indispensable for participatory evaluation and follow-up activities. The FFPMP will continue to monitor the alley-cropping trials and offer technical assistance to farmers through participatory research during the second phase. Other farmers are still reluctant to take on the laborious tasks of alley cropping. They are not convinced by the success of the trials, and continue to practise shifting cultivation. Nevertheless, they are envious of the three active farmers who are expected to facilitate technology transfer to other farmers, based on their experience.

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