Jungle Rubber:

a traditional agroforestry system under pressure

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INTERNATIONAL CENTRE FOR RESEARCH IN AGROFORESTRY

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ICRAF - World Agroforestry Centre

Transforming Lives and Landscapes

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Cover Photos:

Cover page: In a sisipan system young rubber seedlings are planted inside rubber agroforest to gradually replace unproductive trees (*Gede Wibawa*).

Back page:

top: Pak Lahsono of Lubuk village in Jambi is still tapping this rubber tree believed to be over 80 years (*Laxman Joshi*).

bottom: Pak Zainol of Sepunggur village has started tapping rubber trees in an experimental plot(*Ratna Akiefnawati*).

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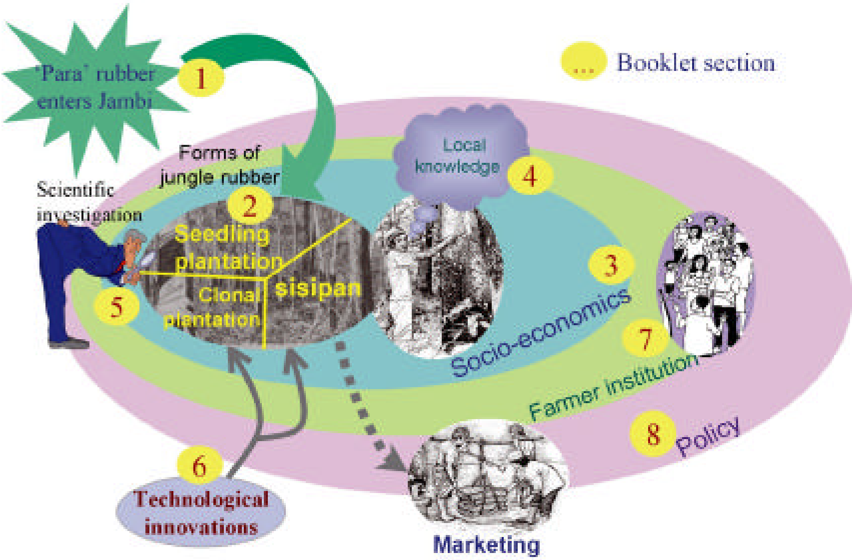
Preface

The International Centre for Research in Agroforestry (ICRAF) began research into rubber based agroforestry systems (*Hevea brasiliensis*) in the Jambi Province of Sumatra (Indonesia) some seven years ago. Various research activities, including surveys and experiments, have been undertaken since then. This booklet contains some of the research findings which were the result of these activities. These findings concern various issues associated with jungle rubber agroforestry, which are specifically relevant to the context of Jambi Province. The booklet has eight sections, each covering different aspects of the system. These are summarised in the following diagram.



Section 1 of this booklet contains information about the beginning of 'Para' rubber (*Hevea brasiliensis)* cultivation in Jambi Province, a process which quickly transformed the landscape of the region. This brief history is followed, in Section 2, by an account of the various forms of jungle rubber which now exist. The socio-economic issues influencing farmers' decisions when they choose between slash and burn and a more permanent system of agroforestry are discussed in Section 3. The local ecological knowledge of farmers is considered in Section 4. Section 5 summarises current scientific understanding of the growth and productivity of jungle rubber agroforests. Section 6 includes brief summaries of relevant experiments carried out in order to develop improvement pathways for jungle rubber. The testing of farmer institutions as a means to garner support and required resources to improve the system in a collective manner is described in Section 7. Finally, Section 8 considers some policy issues that impinge on the production of, and even threaten the existence of jungle rubber agroforestry as a viable option for smallholder farmers in Jambi Province. Examples of real life cases are provided in boxed texts to highlight a number of important aspects of jungle rubber.

The information in this booklet has been compiled from numerous research activities and surveys carried out in Jambi. However, this is not a comprehensive report on such research, nor does this booklet report the findings of all research undertaken by the many institutions active in the Province. The support, both financial and otherwise, provided by Department for International Development (DFID, UK), the University of Wales, Bangor (UK), Institut de Recherche pour le Développement (IRD, France), Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD, France) and the Indonesian Rubber Research Institute (IRRI), Sembawa Research Station (Palembang, Indonesia), for various projects and activities, has been instrumental to our research in jungle rubber. However, these institutions, including donor organisations, are not responsible for the information contained in this booklet.

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1. ‘Para’ rubber in Jambi province

Until the start of the 20th century, Jambi Province in Sumatra (Indonesia) was largely covered by natural forests. It had experienced little economic development, and had a poorly developed infrastructure. Rivers were the main medium of transportation. Most people practiced shifting cultivation and the gathering of forest products, including timber and some latex. However, latex, or ‘getah’, gained importance towards the turn of the century, when demand from industrialized countries for natural rubber increased and created a ‘rubber boom’. The high price of rubber attracted the attention of farmers and colonial (Dutch) officials, and they began to cultivate latex-producing trees.

The first plantations were established in the 1890s, using the local species *Ficus elastica*. Although ‘para’ rubber (*Hevea brasiliensis*, from Brazilian Amazon) was by that time already known in Indonesia, *F. elastica* was the preferred species for latex production because it gave higher yields in field trials. However, preference shifted to *Hevea* after the introduction of improved tapping techniques increased its productivity beyond that of *F. elastica*.

In the early twentieth century, ‘para’ rubber was introduced to Sumatra from Peninsular Malaysia by migrant plantation workers, tradesmen and passing pilgrims. Many local farmers from Central Sumatra went to work in new rubber plantations in Malaysia, both to avoid the taxes and forced labour schemes introduced by the recently-established Dutch government in Central Sumatra, and because they were attracted by the high wages offered by the Malaysian plantations. These individuals returned with seeds and seedlings, as well as with the knowledge and skills necessary to grow and tap rubber trees.

Smallholder rubber was first planted in Jambi in 1904. This event was reported in 1918 by an agricultural extension officer, who observed rubber trees that had been planted in slashed and burned fields, but that were managed (or unmanaged) as though ‘wild’, along with other natural vegetation. This was the first recorded incidence of jungle rubber agroforestry in Jambi. Although ‘para’ rubber was a species used primarily by estate plantations in the early years, it was quickly adopted by smallholder farmers who realised that it fitted into their existing practice of shifting cultivation in crop-fallow systems very well. Rice and other

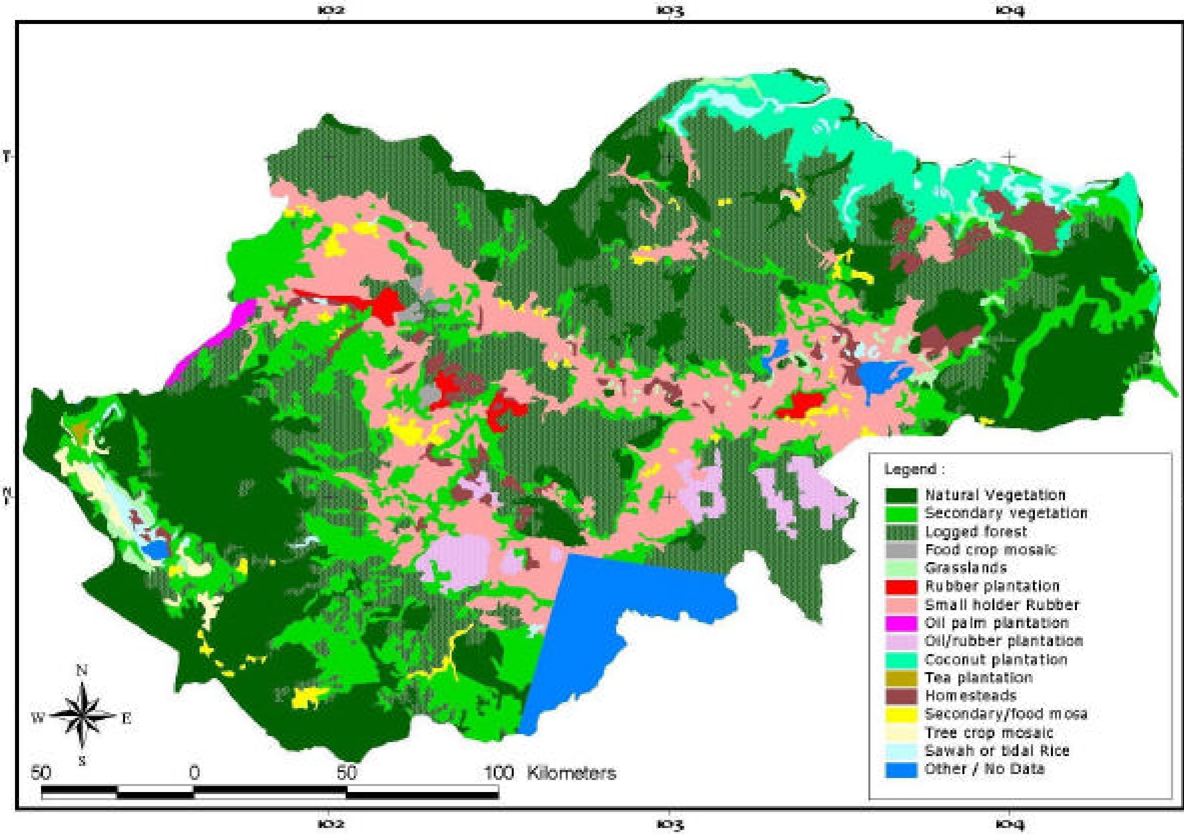

Figure 1. Landuse in Jambi province in 1992 (*Source: Danan Hadi, ICRAF*).

annual crops could still be grown in the first few years of the cycle. Moreover, the existing system of river transport to Jambi town, and its mainly Chinese tradesmen, provided an efficient way to market latex (rubber) from the area. The rapid expansion of *Hevea* in many parts of Indonesia, including Jambi, changed the landscape quickly and forever. Little natural forest now remains in Jambi, as it has been largely replaced by rubber gardens and plantations (Figure 1). The area under rubber in Jambi Province doubled from 1965 to 1985 and continued to increase until around 1993. Since then, the trend has levelled off (Figure 2).

Rubber is a major export from Indonesia. In Sumatra and Kalimantan, the two major rubber producing islands of Indonesia, an estimated seven million people currently make their living from more than 2.5 million hectares of rubber-based agroforests. Smallholder rubber gardens constitute 84% of the total Indonesian rubber production area, producing 68% of its production volume (DITJENBUN, 1999). Jambi Province now ranks third, after South Sumatra and North Sumatra, in terms of latex production, with 97% coming from smallholder farmers with less than 5 ha of rubber gardens. Between 1992 and 1998, the total area under rubber in Jambi increased at a rate of 5,520 ha/year. The productivity of jungle rubber, however remains far lower, at only one third to half (500-650 kg/ha/yr at 100% dry rubber content (DRC)) of the productivity of clonal plantations (1000-1800 kg/ha/year at 100% DRC).

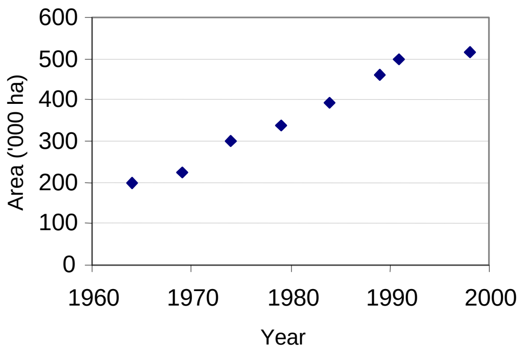

Figure 2. Area of rubber production in Jambi province, Indonesia.

2. Forms of jungle rubber

Because the term forest is associated with conflicts with the State, farmers prefer to use the term *kebun karet* ('rubber garden') to refer to their agroforests. Many farmers rejuvenate their rubber gardens only after production from the old rubber becomes very low. They do so by slashing and burning to start a new jungle rubber cycle, hence called a cyclical rubber agroforestry system or CRAS, Figures 3, 4 and 5, (Gouyon *et al.*, 1993; Joshi *et al.*, in press [b]). In this process, farmers use either locally-obtained rubber seedlings (the traditional practice) or improved clonal planting material. In the

Figure 3. A monoculture rubber plantation that replaced an old jungle rubber agroforest following slash and burn activities (*Photo: Laxman Joshi*).

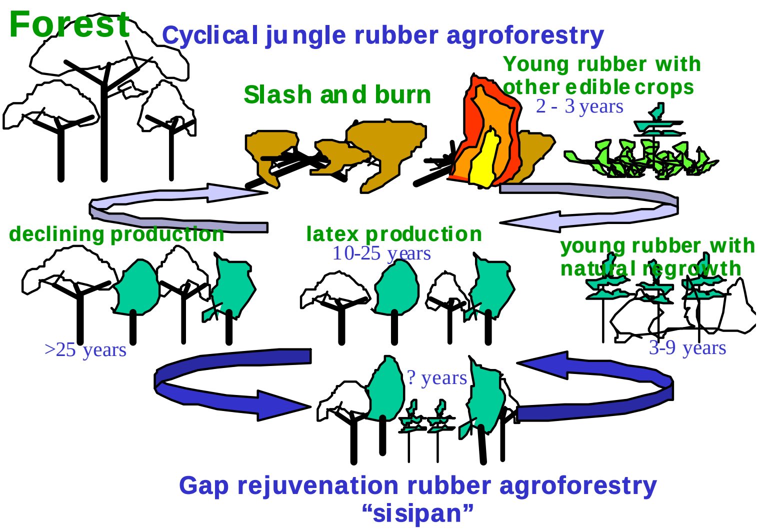

Figure 4. Schematic representation of the *sisipan* and the slash-and-burn system in rubber agroforestry.

first few years, smallholder farmers often plant upland food crops such as rice, maize, soybean, mungbean, pineapple or banana. Estates plant leguminous cover crops while the young plants become established.

Many smallholder rubber farmers lack sufficient capital to invest in the slashing, burning and replanting of rubber trees in their old rubber gardens. This lack of capital is not the only obstacle these farmers face: it is compounded by the fact that most of these plots are the major income source for these households, and by a decline in the availability of land for new planting in the area, as well as by the risk of failure due to vertebrate (wild pig and monkey) pest damage. To address these problems, farmers in Jambi have adopted a different technique of rejuvenation, one that does not require slashing and burning. In the *sisipan* system, new rubber seedlings are planted inside mature rubber gardens, in forest gaps, to replace dead, dying, unproductive or unwanted trees (Figure 6). This technique has the potential to significantly prolong the productive stage of rubber gardens.

Although some farmers perceive the gap replanting strategy as 'old-fashioned' and less efficient in terms of production and management, nearly half of rubber farmers actively carry out gap replanting in their rubber gardens. Some farmers in Jambi have practised this management style successfully for decades, although most seem to have started only

Figure 5. Existing vegetation in either jungle rubber agroforests and natural forests are cleared and burned to start a fresh cycle of jungle rubber agroforest (*Photo: Laxman Joshi*).

Figure 6. Natural or manually created gaps are used by farmers to plant new rubber seedlings in a sisipan system (*Photo: Gede Wibawa*).

within the last ten years or so. As many farmers own more than one plot of rubber agroforest, they are practising both *sisipan* and slash and burn simultaneously in different plots. As socio-economic and biophysical factors vary between villages, the proportions of farmers practicing *sisipan* can be expected to change accordingly.

3. Socio-economic factors and farmer decisions

Research carried out in Jambi, in the Muara Bungo District (in the villages of Rantau Pandan, Sepunggur, Danau and Muara Kuamang) and the Batanghari District (in the villages of Sungai Landai, Suka Damai, Malapari, Napal Sisik, Pelayangan, Rantau Kapas Mudo and Tuo), indicated that about 47% farmers undertake gap replanting in at least one of their rubber gardens (Wibawa *et al*., 2000b).

Farmers gave five different reasons, in the same survey, for carrying out gap replanting in their old jungle rubber gardens:

1. to maintain continuity of income from their existing gardens (89%);
2. because they lacked capital to slash, burn and replant the plot (70%);
3. because they were unwilling to take the high risk of vertebrate pest damage, especially by wild pigs (65%);
4. they had confidence in gap replanting as a feasible approach to rejuvenate an old rubber garden (59%);
5. gap replanting is less labour-intensive, and may be carried out at times when tapping is not practised (36%).

Farmers following a slash-and-burn approach prior to rubber replanting, perceived that ash from the burned vegetation was necessary for rubber seedling growth (67%), and necessary for the successful growth of other agricultural crops (42%). Of these farmers, 30% said that most rubber trees in their rubber gardens were beyond the productive stage, and stated that these had to be replaced; gap replanting was not seen as a viable strategy under these circumstances. Some farmers were interested in planting clonal rubber or were participants in projects promoting clonal rubber (19%) and, again, did not perceive gap replanting as feasible method of rejuvenating their agroforest. Other reasons given for using the slash-and-burn technique included easier preparation of land for crops and rubber plants, as well as the convenience of guarding against vertebrate pests in open fields.

Rubber contributed, on average, 70% of the total household income in the surveyed villages (see Table 1 for details of average household income and expenses). The high dependency of such farmers on revenues from rubber means that those with no alternative source of income are unlikely to use slash-and-burn systems, as income from the replanted plot would stop until the new trees reached the productive stage.

Table 1. Average yearly income and expenses of farmers' households.

Details	**Total in rupiah '000**	**% of total**
Sources of income		
Rubber	4819	69
Non rubber farming	1424	20
Off farms	768	11
Total	*7011*	*100*
Expenses		
Consumption (mostly food)	4344	68
Education	46	1
Other	2028	31
Total	*6418*	*100*

1 US dollar = Rp 7500 (year 2000)

The choice of rejuvenation method (slash and burn or gap replanting) was largely determined by a household's financial strength (their ability to invest in slashing, burning and replanting). Such financial considerations included family labour availability and the household's dependency on rubber for a household income. The risks associated with crop failure, damage by vertebrate pests and fluctuation in the market price of rubber, as well as the farmers' own knowledge and confidence in the gap replanting technique and the availability of land for further clearing, were other driving factors behind the decision to use slash and burn or gap replanting. External factors, such as the availability of government projects and other means of support (capital/credit, land, transport and production inputs) also significantly influenced farmers' decisions and their perception of available options.

Financial calculations have been made, comparing various rubber-based agroforestry systems: the slash-and-burn type (using clonal or seedling plants) and the gap-replanting type. The assumptions made were based on farmers planting agricultural crops in the first two years after slash and burn; farmers can therefore also harvest non-rubber products from jungle rubber gardens in addition to latex. Labour for such projects comes primarily from family members. When additional labour is needed, it is hired at Indonesian Rp 7000 and Rp 5000 for a man or woman respectively. Our financial analysis considered two scenarios. In the first scenario, all production factors were purchased and all products were sold. In the second scenario, only some of the production factors were purchased, while most non-rubber products were consumed within the household.

The financial analysis indicated that, in the first scenario and using clonal rubber, return to labour was Rp 15000 while with seedling rubber, this was about Rp 6600. Under the gap replanting scenario, return to labour ranged from Rp 7800 to Rp 9500. All systems indicated their feasibility (Table 2); however, the gap replanting strategy produced a higher net present value (NPV) largely because of its very low input and labour requirements, compared with other systems.

Table 2. Feasibility indicators of various rubber based agroforestry systems, in which a proportion of the production inputs were not purchased and some of the non-rubber products were marketed.

Scenarios	NPV (20%) (million Rp)	Return to Labour (Rp/day)
Slash and burn systems		
Clonal rubber (moderate yield)	2.85	14664
Seedling (yield :0.5 x clonal rubber)	1.83	6176
Sisipan		
Seedling (constant yield: 728 kg/ha/y)	11.16	7676
Seedling (yield:0.5 x clonal rubber)	11.14	8221

In the current context of the increasing labour wage rate in plantations (Rp 10000) and the increasing price of input material (due to inflation), the low and fluctuating price of latex in the market (Figure 7) makes rubber tapping less profitable in comparison with working as a paid labourer in plantations. This is a choice many rubber farmers in Jambi are currently facing.