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Smallholder Rubber Agroforestry Project SRAP

Complex Rubber Agroforestry Systems in Indonesia : an alternative to low productivity of jungle rubber conserving agroforestry practices and benefits.

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The Jungle rubber agroforestry system : an endigenous alternative to shifting cultivation which fuels development and deforestation (replacement of primary forest).

After plywood, rubber is Indonesia's second most important non-petroleum export commodity. About 12.5 million people in the country are involved in the production, processing and marketing of rubber (Barlow, 1993). Rubber is also the main source of income for smallholder farmers on the low-lying and infertile plains on the islands of Sumatra and Kalimantan. Smallholders produce 73% of Indonesia's total output of rubber, and approximately 1.3 million farm households rely on rubber production for their income. More than two-thirds of these households still grow 'jungle rubber' *(Hevea brasiliensis)* in an extensive complex agroforestry system (A Gouyon, 1995, G Michon and H De Foresta, 1992, 1995, 1996) that covers more than 2.5 million hectares and uses unselected rubber seedlings. However, since the 1960's, by comparison, 60 to 70 % of rubber farmers in Thailand (and 80 % in Malaysia) have adopted improved planting material, clonal rubber, in monoculture system[1].

Complex agroforests have been defined as following :"In a complex agroforestry system, a high number of components (trees as well as treelets, lianas, herbs...) are intimately associated, and the physiognomy as well as functioning of such systems are close to those observed for natural forest ecosystems, either primary or secondary forest". (Michon, De Foresta, 1996)

The jungle rubber system is a low-input agroforestry system, in which rubber competes with the regrowth of the natural forest. In the past, people who grew perennials on land could lay claim to it, so rubber agroforestry systems were a means of acquiring land. Furthermore, the system is inexpensive and requires little labour for establishment and maintenance (Gouyon 1993 and 1995).

After an area is cleared by slashing and burning, rice is planted 1 or 2 years. Subsequently, rubber is planted along with a variety of other useful trees that produce fruit, nuts, timber and rattan. The secondary forest associated with rubber is biologically diverse, and the forest-like environment contributes to good soil fertility and to improve watershed management (de Foresta 1992a).

On the whole, the rubber agroforestry systems are sustainable alternatives to the original slash-and-burn process. The sources of income—rubber, fruit, nuts and other tree products—are diverse and the system can easily be replaced by a new plantation when it surpasses maturity. The life span of the rubber based systems

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[1]In general, low labour costs in Indonesia enable the country to compete well with Malaysia and Thailand, two other rubber producing countries where improved planting material has been made available to farmers, but where wage levels are higher. However, the low productivity of the jungle rubber and the quality of the rubber produced in these systems are major issues for farmers who manage jungle rubber agroforestry systems in Indonesia (Gouyon and others 1993).

is 35 years. It can also be converted into a pure-standing rubber plantation or it can be managed as a fruit and timber agroforest, such as the 'tembawang' system in western Kalimantan.

Low productivity of jungle rubber : a constraint to income sustainability. Farmers' average yield of rubber in this system is low—593 kg per hectare compared with 1065 on private rubber estates and 1311 kg per hectare in government estates (DGE 1993). The low production is due primarily to the lack of availability of improved genetic planting material (IGPM). The majority of farmers do not have access to improved, or high-yielding planting material, technical information, or credit, all of which have been included in technical development packages of the past two decades (Gouyon 1989). Rubber based farming system characterization has been done with a constraints and opportunities analysis in South-Sumatra (A Gouyon, 1995) providing us with very useful information on which the current research programme (SRAP[2]) has been build up.

Jungle rubber covers a vast area in the upland central plains of Sumatra and Kalimantan. These regions have evolved from a purely shifting cultivation system with a low density of population (6 inhabitants/km² in 1920) to a specialization in rubber with upland rice maintained as a first intercrop before establishment of jungle rubber as population was increased, both due to indigenous people or immigrants (in particular from Java) to population density around 30/40 inhabitants /km² in 1996. The low productivity of the system has not enabled so far local farmers to build up a sustainable and cumulative capital surplus although the system in itself is sustainable in terms of environment and production. Rubber has been easily adopted during the century by farmers due to 2 factors : jungle rubber does not compete with the existing foodcrop patterns, as long as land is available, and rubber prices have been usualy sufficiently attractive, although prices may have been low during particular times. Farmers have replaced long fallow secondary forest by a rubber based agroforest with a very similar pattern in term of biodiversity. It is now considered that the main tank of biodiversity in the lowlands of Sumatra and Kalimantan is the areas covered by jungle rubber (H De Foresta...). Biodiversity of jungle rubber is considered as very high and relatively close to that of a primary forest (de Foresta, 1990, Thiollay, 1995). The funny thing is that after rubber has been considered the main cause of deforestation in this century, jungle rubber is now the main source of biodiversity.

Primary forest, entirely covering the lowlands of Sumatra at the turn of the century, represent only 3,5 % of the area in 1993. The landscape is dominated by secondary forest (with slash and burn for upland rice cropping), jungle rubber and oil pam or *Acacia mangium* plantations.

In fact, farmers have evolved from a shifting cultivation system producing staple food (requiring 25/30 ha) to an agroforestry system producing a surplus (based on 4/5 ha of jungle rubber). The next step will be to evolve into a more intensive rubber agroforestry system (on 2 hectares) producing a substantial income in

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[2]SRAP - Smallholder Rubber Agroforestry Project, a GAPKINDO/ICRAF/CIRAD-CP research programme funded by GAPKINDO/USAID

which rice is bought rather than produced on the farm (farm monetarization process). Since rubber planting functions not only as a source of income, but also as a land acquisition process, jungle rubber has permitted the creation of conditions for social differentiation in local communities (A Gouyon, 1995). It is also clear that rubber has increased conversion of primary forest to secondary forest like systems. The increase of population pressure, including spontaneous transmigration from Java, and the establishment of more jungle rubber led to a social differentiation based on land tenure and; later, to income generation according to adoption of innovations or better skills.. In the other hand, the standart of living has also improved and new opportunities (both off-farm or other crops or systems such as oil palm and clonal rubber in monoculture) show now that productivity of jungle rubber is not sufficient to meet farmers requirements in terms of income. Upland rice production is no longer interesting due to the comparative advantage of rice production in Java where irrigated rice productivity has increased to 4 or 5 times with the green revolution. These factors favor farmers specialization in tree crop in Sumatra and Kalimantan, particularly in rubber, and create a demand for high yielding planting material. Together, It is clear that annual foodcrop production cannot be sustained on the red/yellow acid soils of these regions.

So far, farmers have been and continue to be very keen on agroforestry practices to lower their risks, diversify income and to provide access to forest products (timber for housing as well as non-timber forest products such as fruits and nuts, resins, rattan and medicinals plants primarily destinated towards household consumption) as long as the economic driving force of the system, rubber, has a sufficient productivity to raise income.

A scope for improvement of jungle rubber.

The adoption of a productive rubber package, in monoculture or in agroforestry seem to be the only real technical alternative, with oil palm, able to sustain capital accumulation in the long term. The socio -economical conditions for improving productivity and enable capital accumulation with rubber seem to be currently gathered but one might ask : how and for whom ? (A Gouyon, 1985). Technically, the jungle rubber system may be improved, mainly through adoption of clones and selected inputs at a medium level. The technology has to be assessed through an on-farm experimentation with participatory approach and conditions necessary for the adoption of innovations has to be clearly identified. One would expect a very high level of adoption due to the fact that for the first time in rubber research, the research is based on existing situations and indigenous knowledge rather than on an adaptation of techniques originally planned for estates, although some techniques have been derived from the classical clonal rubber monoculture package[3].

The conditions for such an evolution have been identified by A Gouyon (1995) as following: a) pricing policy should enable farmers to raise capital accumulation,

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[3]The classical technological rubber package of existing rubber development projects in South-East Asia (SRDP, TCSDP, N.E.S./P.I.R. in Indonesia) is mainly based on clonal rubber, fertilization during immature period (5/6 years), use of covercrops and high intensity of weeding.

TABLE 1 : RAS ON FARM EXPERIMENTATION WITH PARTICIPATORY APPROACH : the network in the 3 provinces

TRIALS	WEST KALIMANTAN	JAMBI	WEST SUMATRA	NB of farmers
RAS 1				
RAS 1.1 Weeding	2	2	-	25
RAS 1.2 Clone comparison	1	1	-	10
RAS 1.3 Rubber fertilization	-	1	-	1
RAS 2				
RAS 2.1 Associated trees	2	-	-	7
RAS 2.2 Rice experiment	2	1	3	32
RAS 2.5 Cinnamon	-	2	-	4
RAS 3				
RAS 3.2 Covercrops + MPT's	1	-	-	8
RAS 3.3 and 3.4 Covercrop + MPT's + FGT	7			7
Nb of farmers	63 + agricultural school	26 +agricultural school	8	96
BUDWOOD GARDEN	7	4	-	

.The local partners for implementation are the following : Research Institutes : IRRI/Sembawa (Rubber) and CRIFC/Bogor (Foodcrops), development projects SFDP/GTZ (West-Kalimantan) and PRORLK/GTZ (with extension agencies in West-Sumatra). SRAP is funded by GAPKINDO and USAID.

b) the capital accumulated should be reinvested in productive cropping patterns and c) the risk linked to adoption of improved system should be inferior or equal to that of existing systems. The objective of SRAP is to identify technologies that fit the third point. Therefore, as long as improved systems have a cost, and clonal rubber planting material is an important investment, the necessity of adopting a more productive system will probably lead to more social differentiation between those who have access to innovations and those who do not have the sufficient capital. Another differentiation, already seen, is between old rubber producing areas (such as North and South Sumatra) where innovations are partly available and remote or pioneer areas (Jambi, Riau in Sumatra, West-Kalimantan...), in particular in absence of adapted source of credit.

The risk may be assessed through the farmers willingness to follow recommendations with medium level of inputs and labour considering the Imperata pressure. Therefore, on-farm experimentation of Rubber Agroforestry Systems (RAS) will emphasis adoptability through low to medium input and labour investment, with priority to return to labour rather than maximization of land productivity, although RAS technology requires high yielding clones. A prospective analysis of RAS technologies (E Penot, 1996) shows the interest of RAS in terms of labour productivity and income generation compared to traditional systems and rubber monoculture.

In addition to environmental and biodiversity advantages, rubber based agroforestry systems avoid the risks associated with monocrop system due to rubber specialization by diversifying production : fruit (durian, rambutan, duku, petai), nuts (jengkol, tengkawang...), timber and rattan.

Recognition of complex agroforestry systems by Indonesian Authorities, both at the political level and by the research and some development agencies creates a favourable environment to RAS adoption.

These projects have reached only about 13% of the smallholder rubber producers in the country (Tomish, 1992), through very oriented policy such as transmigration (N.E.S.) or block system management unit (PMU/SRDP/TCSDP) and Tomish calculated that it will take 160 years for Indonesia to reach all farmers at such development rate. It is therefore essential, in terms of future development, to develop new alternatives, less costly, in order to reach more farmers.

Improved Rubber Agroforestry Systems (RAS) : a research challenge.

The main challenge for researchers is to test new models for improving smallholder rubber production systems by building on current ones rather than replacing them with estate-type monoculture, conserving the biodiversity and environmental benefits of agroforestry practices. "New models" when Dickjman in his famous book (35 years of research in the South-East, 1951) was already mentioning the traditional techniques "the jungle weeding system" ? Yes because using rubber clones in agroforestry environment, with the required management, is a new challenge for Research.

Increase of productivity may be attained by offering various kinds of improved planting materials to the farmers and evaluating which are most appropriate—and affordable—for smallholders (Barlow 1993).

The research programme is based on 4 major components : a) the characterization of 3 selected provinces to obtain a "situation typology" covering a wide range of conditions, b) a network of on-farm trials using participatory approach, c) a farmer typology reflecting all strategies and constraints encountered in the rubber growing areas of Kalimantan and Sumatra, and d) in-depth studies on particular relevant chosen topics (nutrient cycling, below ground competition, biodiversity.....)

Improved Genetic Planting Material (IGPM) : the first step to overcome the productivity bottleneck.

IGPM comes in two forms. There are clones which have been selected by cross-breeding or chosen from one superior tree and multiplied by grafting. These homogeneous and high-yielding clones are costly, about USD 0.5 per plant in 1996.They also require more labour for maintenance. However, clones have double or even triple latex production compared to unselected rubber trees (average production in clonal rubber smallholding 1500 kg/ha). This planting material has been historically selected for estate monoculture management and optimized for the highest level of maintenance. Including IGPM in agroforestry systems with a certain level of extensive practices means that IGPM will be selected for another environment where competition is far higher than that of monoculture and based on minimization of inputs and labour.

There are also the improved seedlings—clonal or polyclonal. Clonal seedlings are obtained from seeds collected under clonal rubber trees; polyclonal seedlings are those collected in a specific clonal garden with a variety of selected clones. These are relatively cheap, ranging from USD 0.01 to 0.04 per seed, but their production potential must be tested in the agroforestry environment.

Supplying certified clonal planting material to smallholders is a major undertaking. The goals are to raise rubber production from 500 kg per hectare in smallholder agroforestry systems to 1000 or 1500, as well as to increase yields of associated perennial crops in the systems, such as wood, fruit and rattan and annual food intercrops. Testing of improved genetic planting material (IGPM) also includes assessment of rubber production with and without fertilizer. The research aims to identify the key components (use of improved planting material, fertilization, combination...). to improve productivity of the rubber agroforestry systems, which can be established in pioneer and buffer zones, as well as in zones where replanting is required. Production of IGPM by the farmers them self and conditions of adoption are also studied through a village budwood garden programme. It is generally considered that nursery is a specialized activity requiring technical skill and capital. For instance, it is clear that the demand for planting material has generated in the case of the South Sumatra province a supply network of more than 500 private nurseries. Two main problems appear : the price of budded stumps (with an investment of 350 000 rp/ha for IGPM) and the quality of the planting material (the clonal purity is not fully guaranteed). The idea of IGPM production by farmers is not knew and some small scale projects have been launched with limited success. What's new is the acknowledgment of the necessity to understand the conditions of adoption of budding technique by

TABLE 2 : SITES CHARACTERIZATION

factors	West-Kalimantan ***Forest margins with poor soils and transmigration areas.***	Jambi (Sumatra) ***Forest margins***	West-Sumatra ***Very degraded land***
type of population	a) Dayak (Christians) b) Javanese transmigrant (Muslim)	Malayu (Muslim)	Minang (Muslim)
population density	a) low with plenty of land b) high with limited land (2 ha)	low with plenty of land	low with limited land (marginal lands)
ecological environment	a) 2nd forest, jungle rubber and tembawang (*1), poor soils. b)degraded sheet imperata land, poor soils	a) forest and jungle rubber on steep slopes (foothill of the barisan mountains b) forest and jungle rubber on flat areas (peneplains)	Imperata infested land with steep slopes, poor soils, erosion and maximum altitude for rubber (500/600 meters)
farmers' behavior and strategies	a) extensive systems, S&B for local upland rice, willing to accept a low level of intensification b) intensive with sawah and rubber on uplands. Not willing to accept intensification on upland	a) extensive, no upland rice, S&B for cinnamon planting Reluctant to accept labour intensification b) extensive, S&B for rice and palawija production Willing to accept a certain level of intensification	very intensive with continuous food intercropping on tree based systems (rubber) Very keen to intensify
Main constraints	a) low productivity of jungle rubber, Imperata b) very degraded land with imperata on a very limited cropping area (2 ha) High pressure of Colletotrichum (a rubber leaf disease)	a) low productivity of jungle rubber, vertebrate pests on new rubber plantations, b) low productivity of jungle rubber Mikenia Pigs and Monkeys	no sustainable continuous foodcrops systems, Imperata, erosion on very steep slope, erratic rainfall, Remote area, Altitude : maximum for rubber. Rubber leaf disease Low availability of inputs. Pigs depredation
opportunities	a) available land Presence of SRDP/TCSDP *3 Existing old complex agroforestry practices b) farmers motivated	land available Existing old complex agroforestry practices very good access to markets	very good motivation for intensification
On Farm trials priority	a) RAS 1 and RAS 2 b) RAS 2 and RAS 3	RAS 1 RAS 2	RAS 2

*1= Tembawang are indigenous fruit and timber based complex agroforestry systems where the main tree is often Illipe nut tree.

*2 Imperata and Mikenia are majors weeds which limit growth of crops.

*3 SRDP and TCSDP are rubber development projects funded by WB based on clonal rubber monoculture.

the farmers as it is clear that a typology is necessary to identify the regions, the farmers and the areas where village or community budwood gardens may be implemented and where the private sector may be more relevant (or a combination of the two).

RAS On-Farm experimentation : optimization of labour productivity through low to medium input/labour cropping systems.

SRAP is using the participatory approach to do on-farm experimentation with three main kinds of Rubber Agroforestry Systems (RAS) . Referring to ICRAF on-farm experimentation methodology, these trials are type II Researcher designed/farmer managed (Coe R. And Franzel S., 1995). We assessed than both technical and socio-economical sufficient information and techniques were available to set up experimentation at the farm level in order to be able in the next future to release technical recommendations on RAS technology. Therefore, research has been set up right from the beginning with an objective of operationality with emphasis on innovations adoptability. Each trial is being tested for its suitability for local conditions, for low labour and cost requirements and to determine the major technical components and the best level of intensification that can be accepted by local farmers. Various components are tested though different experiments as it is very difficult to deal generally with more than 1 or 2 component at a time in a complex agroforestry. Each trial is fully implemented by the farmer Protocols are evolutive according to preliminary results and farmers assessment of technologies as well as constraints identification. Operationality of research, risk assessment and innovations adoptability, linked with farmers strategies, are key analytical components of the programme. The main objective is to minimize inputs and labour to such an extend that clonal rubber can grow in an forest environment with inputs requirements that are still acceptable by farmers according to their strategies in terms of intensification.

Presentation of RAS trials

The first (RAS 1) is similar to the current jungle rubber system, in which unselected rubber seedlings are replaced by adapted clones. The main objectives are to determine if clonal rubber germplasm thrive in a jungle rubber environment , to double yields and to assess the required minimum management level . A secondary objective is to assess the level of biodiversity conservation in the jungle rubber system. The rubber clones must be able to compete with the natural secondary forest growth. Various planting densities and weeding protocols will be tested. This will identify the minimum amount of management needed for the system, a key factor for farmers which strategies depends on labour and cash availability. RAS 1 requires a certain level of existing biodiversity (old jungle rubber, Tembawang of other type of timber/fruits agroforestry systems, home gardens, secondary or primary forest...) For establishment. In other words, RAS 1 is aimed for planting in pioneer or very remote areas or replanting in old jungle rubber or secondary forest areas. RAS 1 is not suitable in Imperata grasslands (Penot, 1995, de Foresta, 1994).

The second, RAS 2, is a complex agroforestry system in which rubber and perennial timber and fruit trees are established after slashing and burning, at a

TABLE 3 : SRAP benchmark areas characteristics: farmers strategies.

Site Population	Main constrai-ns	RAS type	Innovations adoption rank	strat e-gies	opportuni ties	Sensibi lity to biodi-versity	Sensibili ty to soil conser-vation	RAS adoption constrai-nts	Presen ce of exist-ing project
JAMBI									
Malayu forest buffer zone	monkeys pigs steep slopes	1 2.5	+ +/-	ext ext	timber NTFP cinnamon	-	-	access to clones Mikenia	refores tation project
Malayu jungle rubber peneplain	pigs monkeys	1 2.2	+ ++	ext semi	NTFP palawija	+	-	low upland rice potential	
WEST KALIMANTAN									
Dayak forest	low soil fertility	1 2.2 3	+++ ++ +	ext semi ext	timber NTFP fruits Illipe nut rattan	+++	-	access to clones	SRDP TCSDP
Dayak transmigra tion	very low soil fertility Imperata	2.2	+++	int	off farm work in estate	+++	++	Land scarcity	PKR-GK
Javanese transmigra tion	very low soil fertility Imperata	2.2 3	+	ext	off farm work in estate	-	-	land scarcity access to clones	TRANS
WEST SUMATRA									
Minang	very low soil fertility Imperata steep slopes erosion	2.2	+++	int		-	++	access to clones	Pro-RLK GTZ

density of 550 rubber and a range of 90/250 other perennial trees per hectare. It is very intensive, with annual crops being intercropped during the first 3-4 years, with emphasis on improved upland varieties of rice, with various levels of fertilization. RAS 2 is aimed to answer the following questions : how is total productivity and income affected by intercrops ?, What are the dynamics of species interactions ? And what are the crop alternatives during rubber immature period ?

Intercrops are annual (predominantly upland rice or rotation rice/leguminous such as groundnut) or perennial (cinnamon), during the first years of establishment. Previous experimentation have shown the positive effect of annual intercropping on rubber growth (G Wibawa, 1995, 1996). The range of trees that can be grown in association with rubber in agroforestry associations and the market potential of their products are being examined—tekam, meranti and sunghai trees for timber, durian, rambutan, duku, langsat, cempedak, petai and jengkol for fruit, tengkawang and kemiri for nuts.

The third system, RAS 3, is also a complex agroforestry system with rubber and other trees planted at the same density as that as RAS 2 but with no intercrops except the first year, followed by a combination of covercrops, MPT's[4] and Fast Growing Pulp Trees (FGT). It is established on degraded lands covered by *Imperata cylindrica,* or alang-alang grass (E Penot, 1995). The grass precludes the growth of annual crops so selected cover crops *(Mucuna, Flemingia m., Crotalaria, Setaria, Chromolaena o.....)* or MPT's (*Calliandra*, Wingbean, *Gliricidia*) and FGT (*Gmelina a., Paraserianthes f., Acacia m,)* are established. The objective here is to eliminate the weeding requirement by providing a favourable environment for rubber and the associated trees to grow, supplanting and then preventing imperata growth. All these trials are documented in SRAP methodology project documents (SRAP 1995, 1996). The 3 main kinds of trials have been spited into several types (3 RAS 1, 3 RAS 2 and 4 RAS 3) in order to test 1 or 2 component at a time.

A network of farmer-managed trials is underway in Jambi and West-Sumatra provinces, Sumatra, and in West Kalimantan province, Borneo. 27 trials, with an average of 3 to 5 farm/replications per trial, covering 50 hectares and involving 100 farmers have been established (table 1). Each farmer's field is considered as a replication with 1 or 2 simple treatments such as rubber weeding level, rubber fertilization, rice variety x fertilization, type of associated trees, type of covercrops/MPT/FGT combination.....These experiments take into account the limited resources of smallholders; labour is one the main factors being considered in assessment of a system's suitability. This experimentation is well documented in SRAP province progress reports and methodology documents.

Farmers strategies vs diversity : the necessity for an operational typology of situations.

.The "socio-agro-ecological situations typology".

Three provinces have been selected in Indonesia to cover a wide range of conditions in terms of ecological and socio-cultural and economic factors under

[4]MPT's Multi Purpose Trees

TABLE 4 : particular constraints for RAS adoption

topic	West Kalimantan	Jambi	West Sumatra
previous project access to information	SRDP/TCSDP	-	Pro-RLK
indigenous knowledge and agroforestry practices	+++	+++	-
clone availability	+	+/-	
BLIG availability	-	-	+++
fertilizer use	+	-	-
upland rice HYV availability	-	-	-
seed quality	-	-	-
covercrop seed availability	-	-	-
pests and diseases		monkeys, pigs	pigs
weeds	Imperata	Mikenia	Imperata
rubber diseases	*Colletotrichum*		may be *Colletotrichum* altitude : 550 m : limit to marginal land for rubber
land constraints	very low fertility scarcity in transmigration	slope	very low fertility and slope
upland rice production	with selected local l rice : average potentiality	may be good in peneplains	excellent weeding requires land conservation techniques
RAS adoptability potential			
RAS 1	+++	+++	0
RAS 2.2/RICE	++	+	+++
RAS 2.5/cinnamon	0	0	++
RAS 3	+++	0	+

which farmers have developed a range of strategies for innovation adoption and cropping pattern intensification. All sites are located in equatorial climate, with rainfall between 2000 and 3 000 mm/year, suitable for rubber production which is the main driving force of RAS systems (see table 2). Soils are yellow/red podzolic soils , very acid, with a low fertility status (low content of nutrients and high toxicity to aluminum), in particular in West-Sumatra and West-Kalimantan. As continuous annual foodcrop patterns are not possible on such acid soils (however some transmigration schemes have been based on the contrary assumption in particular in West-Kalimantan which led to failure), farmers oriented their strategies on tree crops among them rubber and oil palm are the main cash crop which are complemented by timber, fruits and NTFP (Non Timber Forest products).

Various populations with different behavior related to forest environment, cropping strategies and resources allocation are taken into account in order to cover a wide range of socio-economic situations. Table 2 gives a summary of these different situations in the 3 selected provinces. Table 3 shows some selected constraints and opportunities of the 3 benchmark areas directly related to farmers strategies and RAS technologies (table 4) .This typology takes into account the socio-economic environment (remoteness, pioneer zones, access to credit, inputs, information....) and the ethnic factor (Dayak, Malayu, Javanese and Minang) which is essential to understand the farmers strategies, and their ability to adopt "new" technologies according to their cash and labour availability as well as their willingness to intensify or not. The establishment of on farm experimentation has been done with preliminary selection of representative zones with various constraints, both technical or environmental (Forest vs Imperata grasslands) and socio-economical (including ethnic groups). Villages have been selected though the following criteria: easy access for easy monitoring, no current rubber project (but old projects may have been implemented), and the presence of farmers motivated to adapt or change their systems. Meetings have been organized in the selected villages to inform farmers on RAS technologies. Some RAS types have been selected according to local constraints and suitability such as : RAS 2 and 3 for imperata grasslands, RAS 1 in forest or jungle rubber environment.....Farmers have been selected on the following criteria : suitability of plots according to selected RAS type, motivation and accessability.

The network may be summarized in the following table :

FARMERS AND AGRICULTURAL SCHOOL INVOLVED IN RAS ON FARM EXPERIMENTATION

Province	Village	Trial	Farmer	Agricultural school
West-Kalimantan	5	15	63	1
Jambi	3	7	26	1
West-Sumatra	1	3	8	-
Total	9	25	95	2