The Improved Genetic Rubber Planting Material (IGPM) availability and use by smallholders in the province of West Kalimantan, Borneo, Indonesia

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Key Words: nursery, budwood, clones, fruit trees, timber trees

Introduction

Rubber production in Indonesia still mainly relies on smallholders' production, with 80% of the production coming from small jungle rubber systems. For the last 20 years, smallholders in West Kalimantan have been given access to clonal rubber, essentially through projects like the SRDP (1981-88), the TCSDP (1989-1997), the NES/PIR programme for transmigrants and some partial approach small scale projects such as P2WK or the PKR-GK project (from Dinas Perkebunan or Disbun, since 1988). Thus rubber monoclonal plantations have been widely developed at the farmer level, although farmers still have no control over its quality and its origin and are not allowed to modify the monoclonal system.

The SRAP project developed by CIRAD in collaboration with ICRAF (Bogor) aims at developing alternatives to this strict monoclonal system, by introducing associated trees in-between rubber trees. In Kalimantan this should be a mean to use the agroforestry knowledge of Dayak people, who for many decades have been using jungle rubber systems.

Three surveys were conducted between June and September 1997 in West Kalimantan to point at the main constraints farmers must face in order to develop their own selected rubber plantations, from plant production to rubber harvesting. The objective of this research is to clearly identify the main shortcomings of the current private nurseries (surveys 1), the constraints faced by farmers in producing themselves their own clones though the SRAP village budwood gardens programme (survey 2), and the identification of the agroforestry practices reintroduced in former SRDP project monoculture plots (survey 3).

Presentation of the surveys

The three surveys tend to cover the main aspects of the rubber production, that is to say:

- survey 1: clonal plant production at the nursery level, by private nurseries,
- by farmers themselves: survey 2;

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- survey 3: alternative systems that would fit farmers' requests, especially agroforestry systems based on associated trees and their density.

Survey I. IGPM availability in private nurseries of the Sanggau area

This survey addresses the technical constraints linked to the rubber IGPM production. Some rubber projects, implemented by Dinas perkebunan (or DISBUN: tree crop extension service) developed in the area mainly rely on this private production. Even the main rubber projects (such as TCSDP or, in the past, the partial approach in some NES), use sometimes the production of these private nurseries, however they generally do have their own nurseries. There is still no guarantee on the clonal purity of rubber plants produced in these private nurseries. The survey main objective is to evaluate the quality of such a material (in term of clonal purity essentially, but also of plant production management) to decide whether it could be used for further plantation or should be removed from any recommendation without serious changes in the production process. The second objective is to have a better insight into this relatively new activity that seems to develop over the years, triggered by a demand by both DISBUN, private companies or even farmers.

A sample of 21 nurseries chosen among the biggest of the area has been surveyed. However, while this survey was carried out, many other private nurseries were being established, and many more will appear in the very next future, considering the growing demand for rubber IGPM. This sample is nevertheless representative of the current problems of this sector.

The main output of this survey is to obtain an up-to-date picture of this booming sector.

Survey II. The SRAP village budwood garden programme: social and technical constraints faced by farmers in the Sanggau-Sintang area

In 1994 the SRAP project initiated an on-farm experimental network in West-Kalimantan [Penot, 1994 #188]. Clonal Rubber Agroforestry Systems (RAS) were proposed as an alternative to unselected rubber plantations and monoclonal system. Farmers rapidly expressed a demand for rubber IGPM (Improved Genetic Planting Material). Community budwood gardens at the village level were established after preliminary discussions with farmers and identification of committed farmers'groups (kelompok petani), and grafting training provided. A first set of budwood gardens initiated in 1995 in the villages of Sanjan and Sungei Kosak preceded a second one, launched one year after, with 6 other targeted villages (Kopar, Engkayu, Embaong, Trimulia and Sukamulia for the Sanggau area, Pariban Baru in the Sintang area).

This second survey addresses the social and technical constraints linked to such a production by local communities, provided with the right information on the basis of self-commitment. Social aspects seem to be the main curb. So far the technical aspect concerning production in itself seems to be sufficiently enlight-

ened if properly provided. But information on quality, i.e. clonal purity, is far not sufficient.

The 8 villages where SRAP has implemented its activities were visited, and all the private and community budwood gardens and nurseries were surveyed, as well as the farmers involved in their management. It is a little bit early in terms of implementation to draw definitive conclusions on most of them but at least, in those established in 1995, it is possible to identify the pros and cons.

Survey III. Use of IGPM in the SRDP-TCSDP monoculture plots in Sanjan

Agroforestry in West-Kalimantan has been widely developed through jungle rubber and tembawang[1] systems by Dayak people. All rubber projects are based on the monoculture technological package that distribute inputs (clones, fertilizers, herbicides and credit. So far the monoculture system is maintained during the whole credit reimbursement period. Almost all farmers in the area accept these conditions, considering the help the credit provides. However, some farmers in Sanjan (33 %), who joined in 1982 the SRDP project (before joining later TSCDP in 1989), changed their former monoculture plots into agroforestry systems by introducing perennials after the reimbursement period.

The third survey was carried out to point out the characteristics of the systems developed by these farmers, and should be used to make the SRAP systems stick to the local people's requirements.

All farmers in Sanjan that have developed agroforestry systems in their SRDP-TCSDP plots were surveyed (14 out of 50 who joined the projects).

Main results on IGPM availability and use in the province of West-Kalimantan

IGPM availability in private nurseries of the Sanggau area (Survey I)

The main private nurseries of the Sanggau area (see figure 1) are located in transmigration villages or small towns along the main road from Pontianak to Sanggau. The sample of the survey I (chart1) consists in 22 farmers from 4 locations:

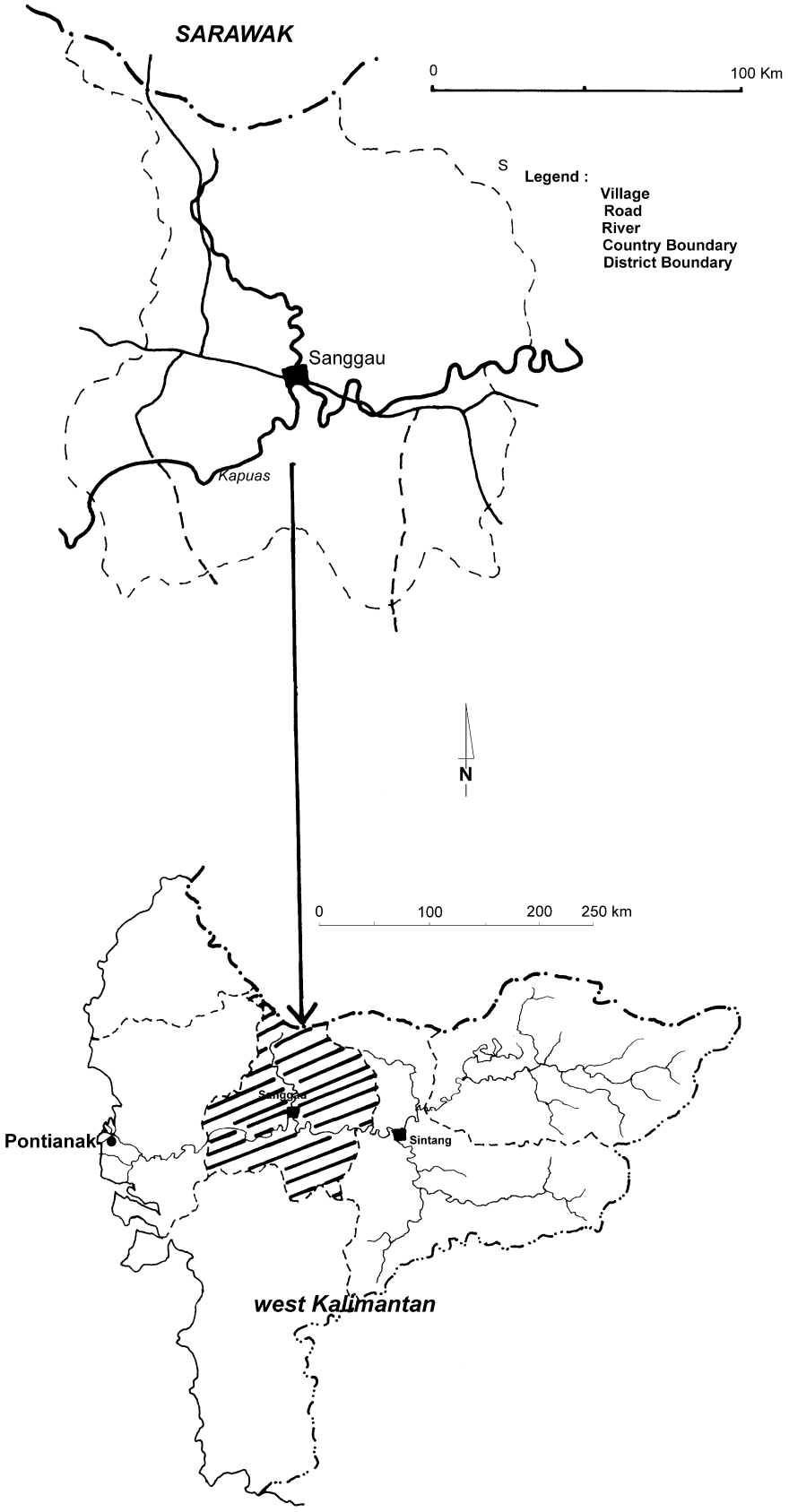
- The well-developed transmigration village of Sukamulia.
- The town of Pusat Damai (Bodok).
- The Sosok and Tanjung surrounding area.

The initiation of clonal rubber projects in West Kalimantan in 1981, with the SRDP, pushed on for IGPM demand, and the first nurseries appeared in 1984, although on a small scale. The real start was in 1989, when Disbun was asked to supply IGPM for the TCSDP. Due to its incapability to support the demand,

[1] Tembawang are fruit/timber based complex agroforestry systems traditionally developed , even before jungle rubber, by dayak communities.

Disbun triggered the IGPM production in Sukamulia by providing grafting training, budwood and basic technical information about clones in order for private nurseries to be able to provide the required planting material. This new opportunity for transmigrants (20 out of 21 farmers surveyed) to increase additional income from agricultural activities on poor soils where food crops agriculture is not sustainable, rapidly boosted the production (from 1989 to 1991). Many nurseries that had not been established with the help from Disbun were established later in Sukamulia by farmers on their own (chart3). Before the booming market, farmers from the surrounding villages in the area started also to develop this new production activity by themselves (from 1994), and in 1997, many small private nurseries for private use or for sales were being established in the area. With the constant increase of the demand for clonal rubber plantations in the province, farmers hope a boost of sales demand.

Figure 1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Pontianak
Sintang
west Kalimantan

A familial production system on a small area

The sampled population of private nurseries (21 farmers, chart 1) is essentially composed by male farmers (20 out of 21 farmers), mostly migrants. The average farmers'age is about 41 years. The plots used for the establishing of the nurseries and budwood gardens are former idle plots with low fertility, covered by *Imperata cylindrica* (chart4), closed to the house or the sawah, most of the time owned by the farmers (chart2). Only 3 farmers rent plots from other farmers, but due to their low fertility, the annual cost remains very cheap (free for 2 farmers, 20.000 Rupiah for the other). One farmer use his old unselected rubber plantation to plant rootstocks as an intercrop.

Chart 1. Number of farmers surveyed by location

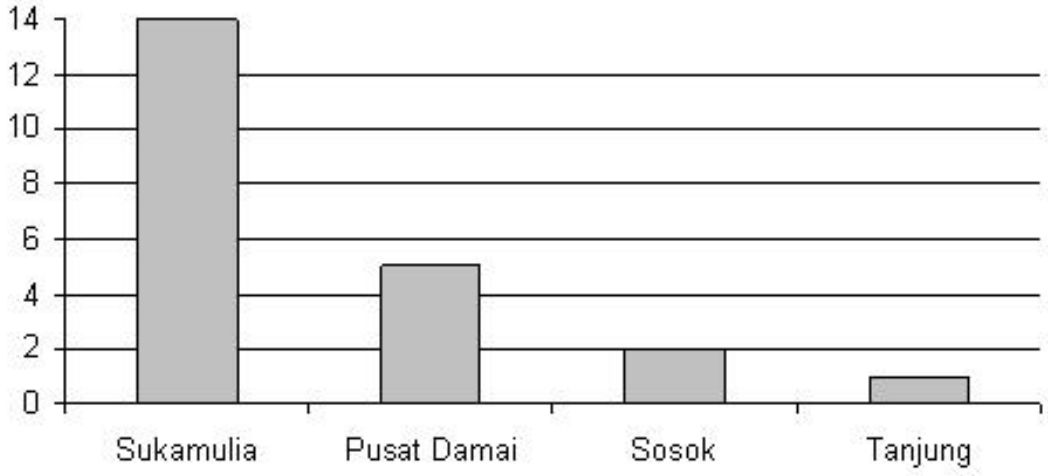


Chart 2. Status of the land used for the nursery and the budwood garden

Chart 3. Number of farmers initiating the IGPM production by year

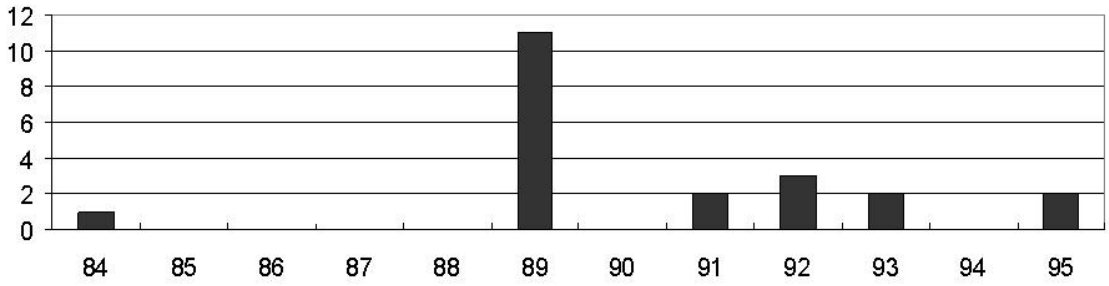
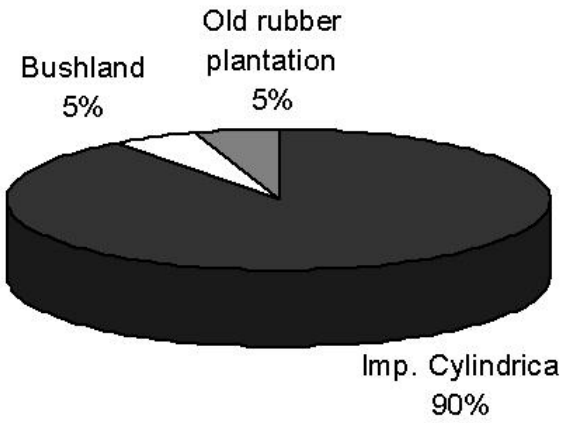


Chart 4. Status of the land before the IGPM production installation



The labour force is in average around 2 to 3 people (chart 5), which corresponds to the head of the family, his wife, and the oldest child still living in the village. Few farmers rely on external part time labourers (3 farmers only), essentially during the grafting period (average of 2 part time workers). These casual labourers are all inhabitants of the same village, generally neighbours, and work for a small wage including lunches (Chart 7).

The average area devoted to the nurseries is 0.33 ha (Chart 6), and 1/3 of them is above the average. There is no real big-sized nurseries specialized only in IGPM production and this production is always an additional source of income to the usual farming activities. There is no particular relation between the size of the nurseries and the labour force involved, and some big nurseries have less full time labourers than some small ones.

Chart 5. Total staff and part time staff working in the nursery

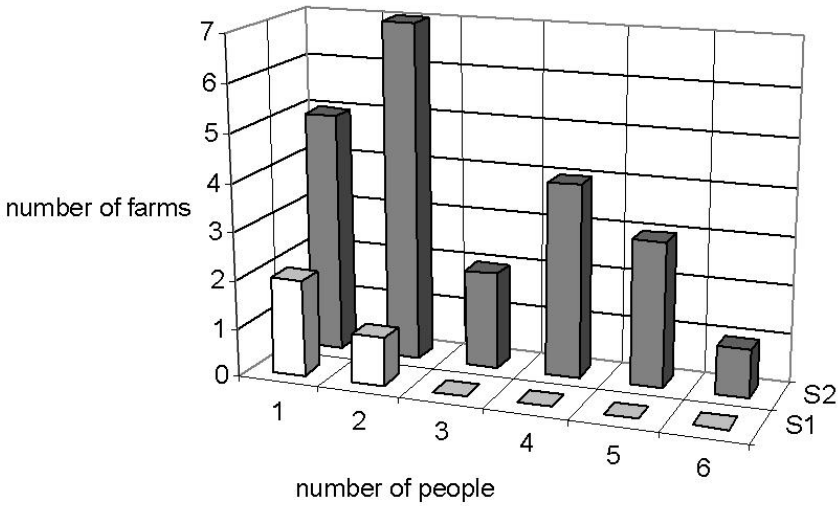


Chart 6. Nurseries area compared to the mean (in ares)

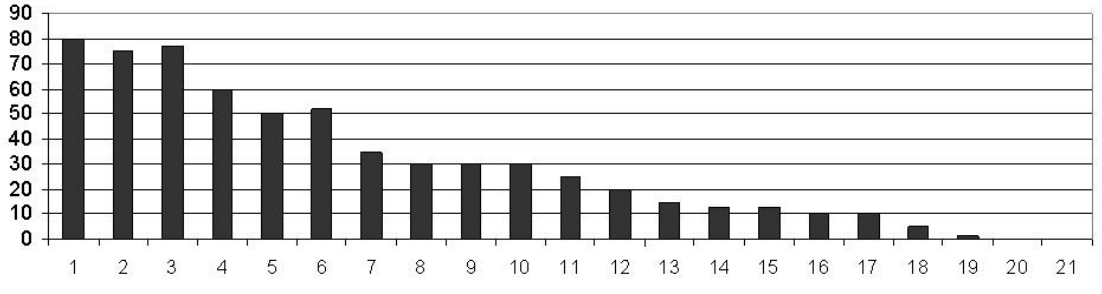
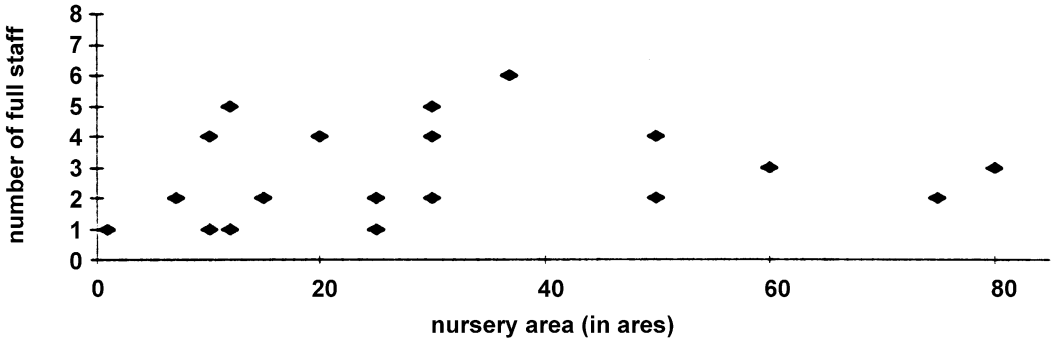
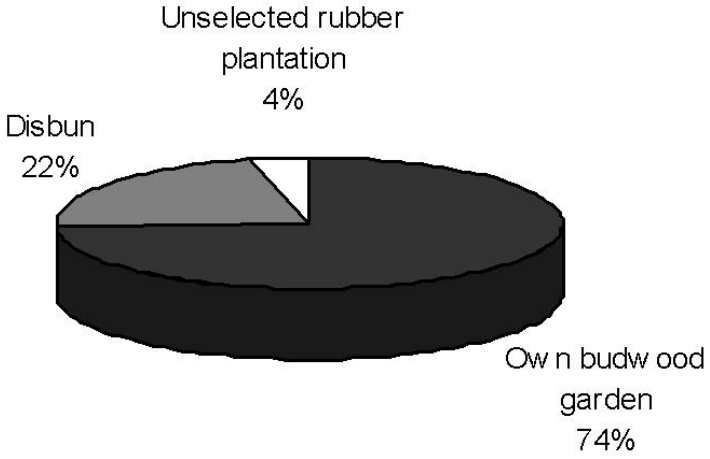


Chart 7. Full staff in relation to the nursery area



74 % of nursery owners use their own budwood gardens for bud production (Chart 8). The purity of budwood gardens in West Kalimantan remains one of the most important problems to develop more widely the clonal plantations. This is the result of confusion made for many years and a poor management of the government budwood gardens that supply most of the budwood. The budwood garden purity at the national and regional level is still to be enhanced

Chart 8. Origin of the budwood for grafting



The situation in IRRI/Sembawa; one of the main official source of planting material

The IRRI/Sembawa's budwood garden was assessed by CIRAD-CP using its electrophoresis method in 1992 to check the clonal purity. To enhance the difficulty to recognize the different clones, the electrophoresis was conducted after the IRRI specialists had named the clones according to their knowledge.

The report enlightened two different but important points. The clonal purity of the budwood gardens, which has been widely used to provide Disbun's own budwood (especially in West Kalimantan), is far from being good. Only one clone is 100% pure, the others are a mix between several clones (sometimes from different names) and even unselected rubber, since the electrophoresis was unable to point out a name although its large database. Purity rates may be below 20% for certain clones.

The rate of good recognition by specialists is very low (under 50% for some clones) and many confusions are made between clones. Sometimes they are even unable to give a name to some of the plants.

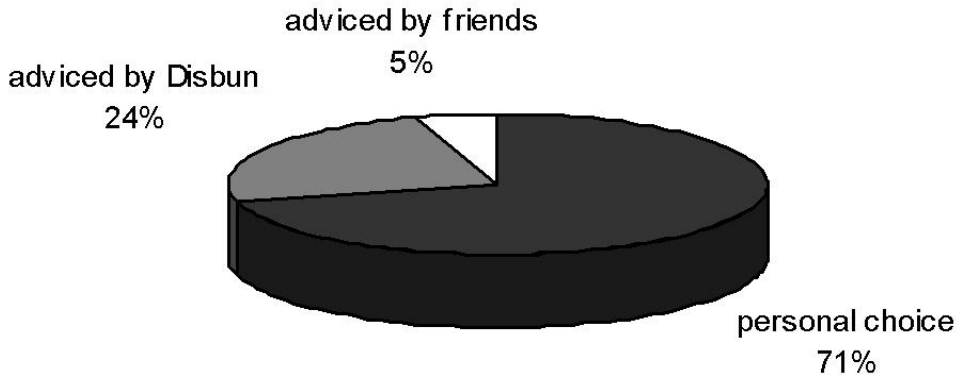
That enlights first the difficulty to recognize visually a clone, therefore to easily check its purity, and second, the fact that clonal purity is not even fully guaranteed at the very origin (Research Station) however all efforts are done to obtain the best pure planting material in these institutions.

The situation in West Kalimantan

From this original Sembawa's budwood garden, Disbun established its own budwood garden in Sanggau. Thus, since the beginning, all the clones issued from Sanggau by Disbun are "faked" clones with a poor clonal purity rate for most of them. From 1989 to 1994/95, budwood and clonal plants for private budwood gardens establishment were mainly provided by Disbun through its own budwood garden. Now, many farmers establish their budwood gardens with

plants from other private budwood gardens (chart 8), but to date Disbun remains the main supplier for private budwood garden. In private budwood gardens, 59% of the farmers pretend to detect differences between plants for the same clone but none of them pull up these plants to purify the plot, in order to maintain production as long as no consumer asks for quality (chart 9).

Chart 9. Choice of the current clones



In addition to this low original clonal purity, it seems that from producers to users (farmers), through official institutions (in particular Disbun), there is an obvious insufficient care and attention given to quality of planting material and clonal purity of the rubber planting material. Farmers have developed IGPM production activity to have additional sources of income besides other farming activities. However, most of them still ignore the quality requirements for such a production, and neither Disbun nor the projects had sufficiently enlightened the need for it.

Thus, farmers have a poor knowledge of clones and what clonal purity is. First they have no knowledge of the differences between clones in term of growth and production characteristics, or resistance to diseases. Therefore most of them do not pay attention to clone diversification (chart 10 & 11 & 12). Second they are not susceptible to the importance of quality in the production process. Clones are mixed in the nurseries during the grafting period and there is no guarantee for the final users of the type of clone that is provided. Due to budwood shortage, some farmers even graft rootstocks with buds from local rubber. There is no easy possibility for the final user to recognize a clone.

Chart 10. Detection and purification of the wrong plants

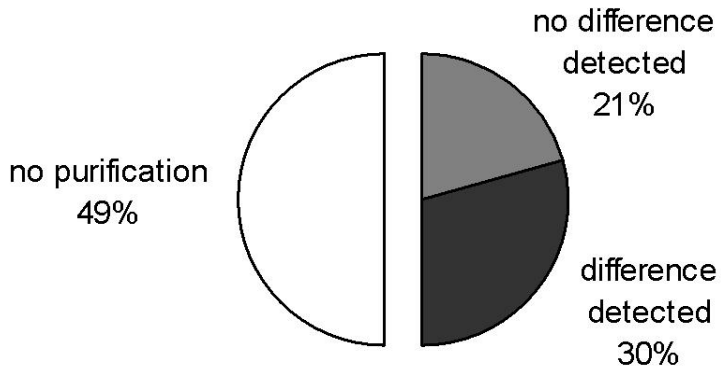


Chart 11. Percentage of farmers who heard about clones before they produce IGPM, and who know why there are so many clones

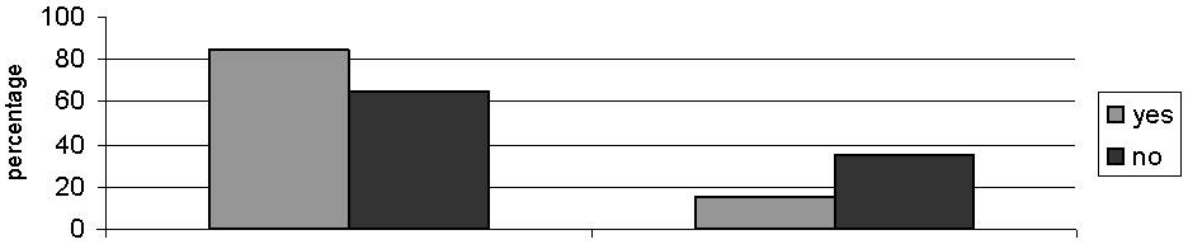
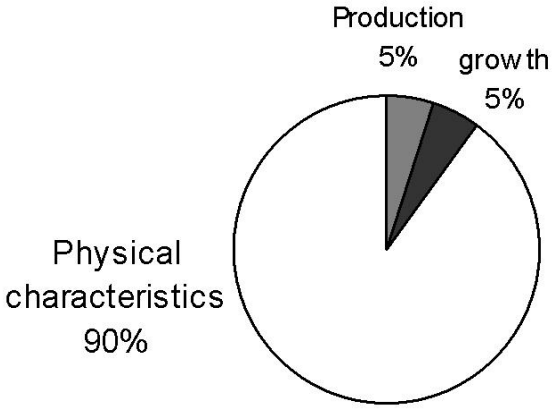


Chart 12. Interclonal differences known by farmers



Budwood gardens and nurseries in West-Kalimantan

A poor management resulting from a lack of acute information and incentive for good quality IGPM. Clones requirements information is unknown to farmers. The first information farmers get about clones where provided by official institutions or projects in the early 90's (Disbun, SRDP/TCSDP, SFDP, 73%). Only 14% where taught by friends and/or relatives (chart 9).

86% of the farmers says they have already heard about clones (chart 14). 18% affirm they can recognize clones by themselves, although this may be considered as overestimated. Although 68% pretend to know that there are different clones for different situations, only 2 farmers have a real knowledge of clone's differences in term of growth, production and resistance to disease (chart 15). The others are only able to partially see some physical differences between clones. Few farmers know which clones are the most adapted for monoculture, although this system has been widely developed in the area. Only 4% of the sampled farmers have an idea on the type of clone suitable for rubber agroforestry systems (chart 13). It is important to mention that until very recently, nobody had any ideas about the best clones for an agroforestry environment, depending on the type of agroforestry (complex as in RAS 1 with secondary forest or with fruit and timber trees as in RAS 2 see paper 1).

Chart 13. Do you know which clones are the most adapted…

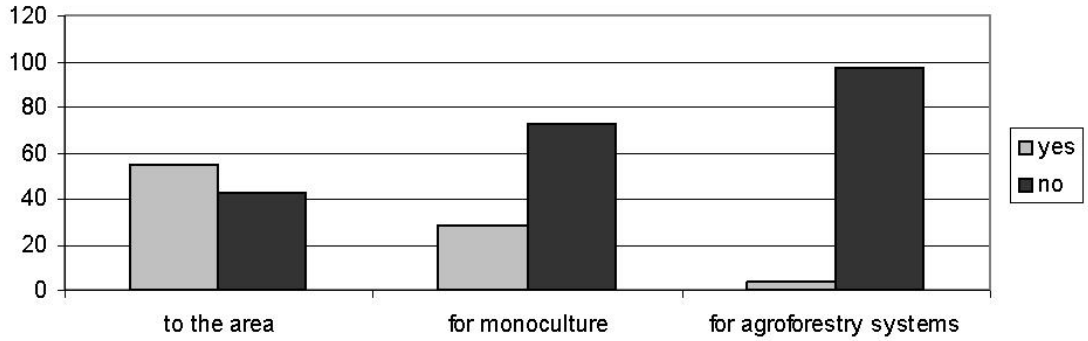


Chart 14. Where from did you heard about clones for the first time?

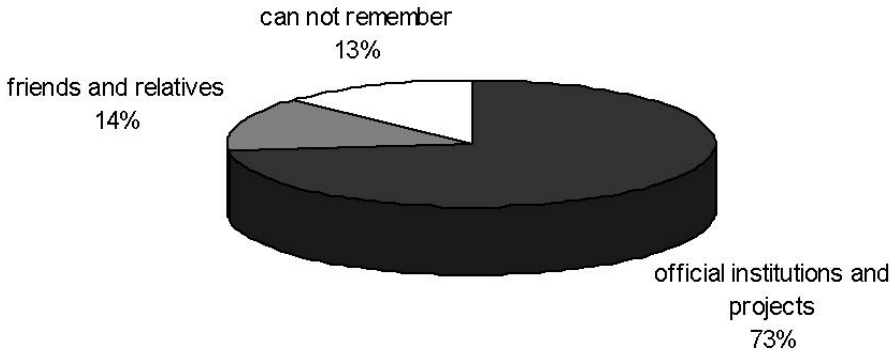
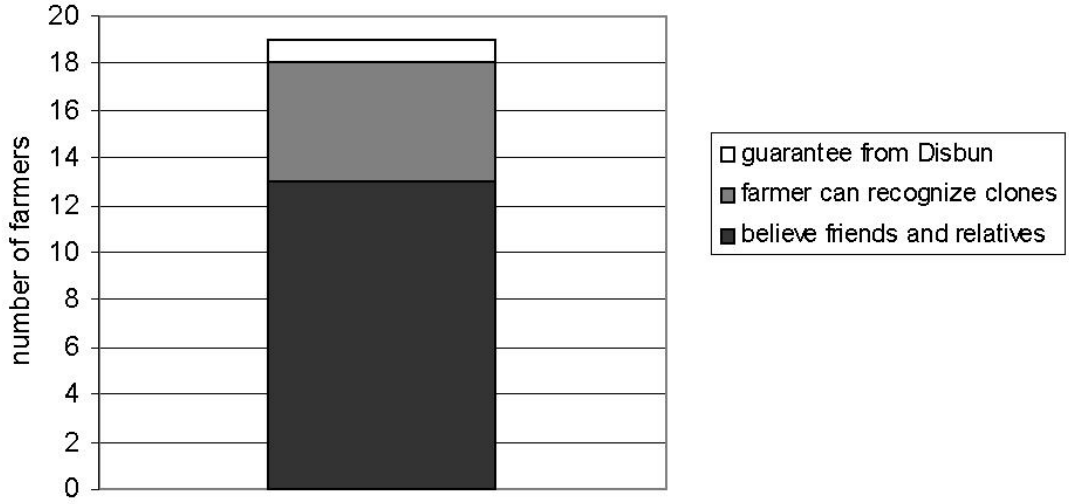


Chart 15. How do you know your clones are those you think?



Generally, the answers concerning the clones quote Disbun's advises, and show that farmers are greatly influenced in their opinion about clones by the institutions (chart 14). Farmers are generally unable to assess the quality of information provided.

The private budwood garden management in the Sanggau area

Within our sample, 77% of the farmers have their own budwood garden, and 15 out of 21 say they personally chose the clones they wanted, but they are not able to justify on which criteria they did select them. Others were advised by Disbun or other official institutions. Only 5 farmers rely on external budwood (from Disbun or projects).

The first statement of the first survey is that the nursery owners do not have a proper and good management to ensure the clonal purity of clones sold or self-used later on. It seems they are all aware of the superiority of clones over unselected seedlings, but without awareness of the real differences between clones. Their only immediate worry is to produce "clones" to supply the demand (chart 16), in particular when the demand does not requires any quality specifications. Thus they choose the easiest way for grafting, which is to mix up the budwood during the transportation from budwood garden to nursery for later grafting, regardless of the clonal purity. Some farmers do not even know which type of clones they graft, even those having their own private budwood garden.

Chart 16. Purchasers of the IGPM production in 1996

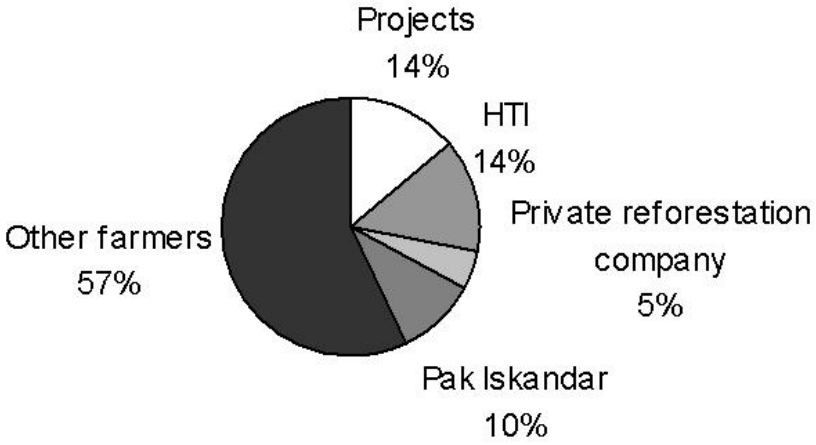
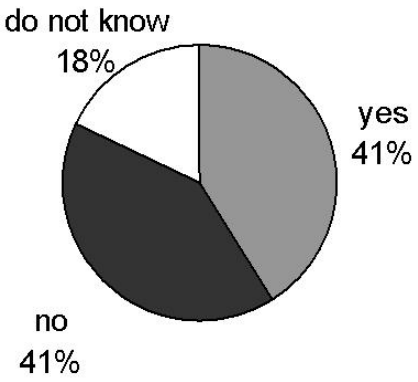


Chart 17. Do you intend to increase your production next year?



The second statement is that most of the time, the actual production does not match the production enabled by nurseries size and clonal budwood availability (self-produced or bought from outside the farm). Only one farmer agrees to recognize that he uses buds from his unselected rubber plantation. However, the comparison between both actual and enabled production enlightened that 50% of the farmers seem to use budwood from older unselected plantations. In other words, quantity overcomes quality (chart 17). No quality requirement is demanded by final consumers (basically DISBUN, other projects and local farmers), due to lack of technical accurate and up-to-date information. That policy, where Disbun is a major clone's distributor beside TCSDP, leads to the current situation:

- plantations with mixed clones and "faked" clones,
- decrease in production potential. Eventually, before the low productivity of the so called "clones" ("faked" clones), this might lead to a disaffection from producers to intensification using clones.

Economic analysis of clonal stumps production in private nurseries.

The use of inputs is quite important in the stump production process:

- for the budwood gardens: 71 % of farmers use herbicides, 82 % use urea and 41 % use KCL and SP36 (Phosphorus). 29 % only use pesticide when Colletotricum (leaf disease) is a major constraint. The average annual expenses for budwood gardens is Rp87,000 (Table 1).
- for the rootstock nurseries: 57% buy budwood, 95% of farmers use herbicides, 81% use urea, 48% use KCL, 52% use SP36 and 43% use pesticide (Table 2 and 3). The average annual expenses for nurseries is Rp277,000
- for the grafting: 33 % of farmers buy the budwood. Only 14 % use extra staff for grafting (Table 3).

Table 4 displays the average production costs distribution. Chart 18 shows the cost and benefit per product (stump and stump in polybag). The relatively low input use and poor quality explains the low cost of planting material compared to that of Jambi (350 Rp/stump and 1000 Rp/polybag). The benefit per plant is sufficient to explain in itself the success of nursing activities when demand is sustained, in particular for farmers with limited and very poor land (Imperata grassland).

The private budwood gardens

Table 1. **Total investment for private budwood gardens**

Products	Average cost (Rp)	SD	CV	Number of farmers	
Herbicide	23.275	17.734	0,76	12	71 %
Urea	32.071	32.205	1,00	14	82 %
SP	26.786	26.643	0,99	7	41 %
KCl	32.643	25.877	0,79	7	41 %
Other fertilizers	4.750	2.165	0,46	4	24 %
Pesticide	10.200	11.124	1,09	5	29
Total	86.736	81.612	0,94	14[2]	82 %

[2] Among the 17 farmers owning a budwood garden, 3 do not invest into any fertilizer or herbicide.

Table 2. **Total investment for private nurseries**

Material/products	Average cost (Rp)	SD	CV	Number of farmers	
Buying of rootstocks	89.542	60.212	0,67	12	57 %
Herbicide	79.937	63.975	0,80	20	95 %
Urea	82.235	66.813	0,81	17	81 %
SP	75.341	105.483	1,40	11	52 %
KCl	45.250	21.734	0,48	10	48 %
Other fertilizers	15.000	11.730	0,78	5	24 %
Pesticide	17.889	10.949	0,61	9	43 %
Total investment	276.821	187.574	0,68	21	100%

The grafting in private nurseries

Table 3. **Total investment for grafting**

Items	Average cost (Rp)	SD	CV	Number of farmers	
Plastic	50.655	48.481	0,96	21	100
Budwood	135.750	81.317	0,61	7	33%
Allowance to grafters	1.129.667	733.767	0,65	3	14%
Total input	257.285	497.467	1,93	21	100%

Table 4. **Production costs for grafted plants (stumps and polybags)**

Items	Average cost (Rp)	SD	CV	Number of farmers	
Total investment (BG + nursery + grafting) (in Rp)	579.347	619.358	1,07	21	100 %
Number of stumps sold	19.307	15.171	0,79	21	100 %
Production cost for stumps (in Rp)	32	18	0,56	21	100 %
Number of polybags sold	500	0	0	2	10 %
Buying of polybags	50.000	0	0	2	10 %
Production cost for polybag (Rp)	112	2	0	2	10 %
Total sales (Rp)	4.293.750	3.399.595	0,79	21	100 %
Total benefit (Rp)	3.714.402	3.010.841	0,81	21	100 %
Price (Rp)					
of one stump (in Rp)	220	16	0,07	21	100 %
of one polybag (in Rp)	600	100	0,17	2	10 %
Benefit (Rp)					
per stump (in Rp)	187	18	0,10	21	100 %
per polybag (in Rp)	487	102	0,21	2	10 %

The current trend: an increasing demand for clonal plants

In 1996, the main purchasers for this IGPM production were: projects (HTI = hutan tanaman industri and TCSDP), a local private company for reforestation, and indirectly DISBUN (chart 16). DISBUN officially provides IGPM to farmers but does not have sufficient means for total production. Therefore, DISBUN officers buy IGPM to private nurseries in order to fulfil their requirements. It is interesting to see that many farmers do not even know their final purchasers, especially in Sukamulia: they directly sell to traders (other farmers from the village) who then sell to final purchasers. It is the case for 55% of the people surveyed. None of the farmers intends to prospect new clients as traders, so far, have succeeded in selling their production.

Obviously, the market for rubber clonal plants will still be growing on, although the demand for oil palm plantations has become stronger for the past few years. 41% of the farmers want to increase the production for the next few years, although the same percentage does not envisage any increase. They intend to increase the nursery area and the number of rootstocks. Many new farmers plan to establish their own nurseries, and on a smaller scale, a private budwood garden. Therefore, we can expect an increasing production for the next few years without any control of the clonal purity. To that respect, we can qualify the IGPM private production system as total anarchy.

Conclusion on survey I

These results show that IGPM production, started 10 years ago in this part of West Kalimantan, was triggered by a growing demand from projects and extension institutions as well as farmers who can afford investments in improved planting material. Many farmers are ready to invest in this new activity which seems to be highly profitable, requiring few inputs on a small area, perfectly suitable for spontaneous migrants with a limited land access. The current situation, characterised by total anarchy, mix of clones, no clonal purity, lack of certification and even production of "faked" improved planting material (stumps grafted with unselected budwood), will lead to a serious problem in few years with low quality plantations, a serious decrease in production, and the distribution of plants that are not resistant to leaf diseases, in particular *Colletotrichum*. Farmers are not sufficiently aware of the technical constraints required for a good quality of planting material, and favour quantity rather than quality.

Extension institutions being one of the main clients and, at least, those who triggered that activity, they have a certain responsibility in this current situation. A reform of the system should include the following points:

- certification of the planting material,
- technical support to private nurseries,
- clonal purity control in official budwood gardens as well as private budwood gardens, and
- training for grafting for new nurseries.

In other words, in order to maintain high productivity in new plantations using clones, a quality based planting material policy should be adopted by all the actors of the IGPM commodity system: from the producers to the consumers.

The SRAP budwood garden programme (Survey II):
social and technical constraints faced by farmers in the Sanggau-Sintang area

The SRAP project

In 1994 SRAP project initiated an on farm experimentation network in West Kalimantan. Clonal Rubber Agroforestry Systems (RAS) were proposed as an alternative to unselected rubber plantations and clonal rubber monoculture system.

As a result, farmers rapidly expressed a demand for rubber IGPM, namely for clones as no other planting material was really known (such as polyclonal seedlings). After discussion with farmers, community village budwood gardens were established, and grafting training provided to farmers through SRAP project. A first stage was initiated in 1995 in the villages of Sanjan and Sungei Kosak, both in the Sanggau area. In 1996, 6 other villages were targeted: Engkayu, Kopar, Embaong, Trimulia and Sukamulia for the Sanggau area, and Pariban Baru in the Sintang area. The results between villages are very different due to social or technical constraints encountered. Table 5 displays the potential of production per garden. Table 6 shows the number of nurseries and the potential production per village in 1997. Table 7 displays the number of farmers involved in farmers groups and those who have effectively implemented a nursery. Table 8 shows the number of farmers that have eventually effectively implemented a nursery. Table 9 shows the percentage of farmers in the kelompok who own a private nursery

***Table 5*. SRAP budwood gardens composition in July 1997**

Village	Year of planting	PB 260	RRIC 100	RRIM 600	BPM 1	Potential production for 1997 ('000)	Potential plant production ('000)	Potential area (in ha)
Sanjan	1995	50	50		50	300	1200	2,00
Pariban Baru	1996	148	78	44	75	345	1380	2,30
Trimulia	1996	150			100	250	1000	1,67
Embaong	1996	40	94	42	44	220	880	1,47
Kopar	1996	135	43	53	69	300	1200	2,00
Engkayu	1996	48	16	50	21	135	540	0,90

Table 6. **Potential production for plants ready for planting/sales per village**

Village	Nb of nurseries		Potential number of plants		Potential area to be planted (ha)	
	P*	C*	P	C	P	C
Kopar	2	-	460	-	6,67	-
Pariban Baru	5	1	5.280	1.200	8,80	2,00
Embaong	1	-	20	-	0,03	-
Sanjan	6	5	1.740	1.770	2,90	2,95
Engkayu	1	-	400	-	6,67	-
Trimulia	5	-	10.000	-	16,67	-
Total	20	6	17.900	2.970	29,83	4,95

* P = private, C = common

Table 7. **Kelompok composition in the SRAP villages**

Village	Number of kelompok	Number of members	Number of farmers owning a private nursery
Kopar	1	5 + 7[3]	2
Pariban Baru	1	9	5
Embaong	1	10	1
Sanjan	5	12, 12, 12, 11, 9	6
Engkayu	1	15	1
Trimulia	1	56	5

[3] 5 farmers previously formed the first kelompok, then 7 others joined the kelompok.

Table 8. **Nurseries average area, and average number of plants per farmer, in nurseries and BG.**

Villages	Average number of plants per nursery[4]		Number of root-stocks per farmer in the kelompok	Actual budwood available per farmer in 1997 (in m)	
	P	C		potential*	actual**
Kopar	1.150	-		25	150
Pariban Baru	5.280	1.200	133	38	68
Embaong	200	-		22	220
Sanjan	1.450	1.770	158	5	47
Engkayu	2.000	-		9	135
Trimulia	10.000	-		4	45

* compared to the total number of farmers in the kelompoks

** compared to the number of farmers actually owning a private nursery

Table 9. **Percentage of farmers in the kelompok who own a private nursery**

Villages	Number of private nurseries	Number of farmers in the kelompok	% of farmers in the kelompok owning a nursery
Kopar	2	12	17 %
Pariban Baru	5	9	56 %
Embaong	1	10	10 %
Sanjan	6	56	11 %
Engkayu	1	15	7 %
Trimulia	5	56	9 %

Transmigration villages: a nursery specialisation process

Among the 8 villages, 3 are inhabited by transmigrants (Javanese in Trimulia and Sukamulia; Melayu in Sungei Kosak). The success of the SRAP project is obvious in the two Javanese villages, but lead to a complete failure in Sungei Kosak.

Sungei Kosak: off-farm activities and short-term strategy

Before the SRAP project, both SRDP (1981-82) and PKR-GK project (1993) were proposed to farmers in Sungei Kosak. The first start with SRDP was perceived by farmers as a failure, since information and skills were not sufficiently enlightened, and the current production of the plots is very low. Therefore farm-

[4] plants to be planted or sold.

ers became reluctant to other rubber projects. When SRAP proposed a community budwood garden in 1995 they nevertheless accepted and 10 farmers followed a grafting training. SRAP has also been a failure, due to no social cohesion that led trained farmers not to skill the others. As a result, many farmers owned a nursery but were enable to graft it, and to date no stump has been grafted. Moreover, a short-term strategy with emphasis on sawah production (that lead farmers to use fertilisers provided for plantations in sawah, irrigated rice), and off-farm activities (many farmers also work part-time as carpenters in Sanggau) have been factors that prevent success in using clonal rubber for their own plantations.

Trimulia: on the way to success

In Trimulia, farmers also have this short-term strategy based on sawah production and off-farm activities. The few land they received from the Transmigration Department (2.5 ha) does not permit extensive systems. They adopted RAS trials in 1996 on a relatively extensive way (rice intercropping has been a failure due to poor management for the first year). However, farmers seem to realise the advantages they could get from IGPM production activity, which allows a high profitable production on a small area (as it is the case for the village of Sukamulia). Thus they are about to develop a trading policy for IGPM. Some farmers established their rootstock nursery. Many of them also intend to increase their production. Trimulia seem to be on the way to success (table 10).

Table 10. **SRAP budwood gardens composition in July 1997**

	Year of planting	PB 260	RRIC 100	RRIM 600	BPM 1	Potential production for 1997 (in m)	Potential plant production	Potential area (in ha)
Sanjan	1995	50	50		50	300	1200	2,00
Pariban Baru	1996	148	78	44	75	345	1380	2,30
Trimulia	1996	150			100	250	1000	1,67
Embaong	1996	40	94	42	44	220	880	1,47
Kopar	1996	135	43	53	69	300	1200	2,00
Engkayu	1996	48	16	50	21	135	540	0,90

Sukamulia: an example of specialisation in nursery activity

Farmers in Sukamulia also have 2.5 ha, but they have for long developed the IGPM production. First, Disbun triggered this new activity and targeted Sukamulia as an informal producer for its own clonal production. Gradually, beside Disbun and other projects (HTI), some farmers began to buy IGPM, and Sukamulia go on developing the activity. When SRAP village budwood garden was proposed in 1996, some farmers already had their own budwood garden provided by Disbun on a small scale with no guarantee of clonal purity Thus they did not catch the opportunity to rely on a community budwood garden with high quality

planting material. To date, few farmers want to use the SRAP budwood garden due to the fact that there is no real demand or incentive for real good quality budwood for planting material from the final users (mainly Disbun).

Traditional Dayak villages: social cohesion as a key to success

For Dayaks, who for many decades have experienced jungle rubber systems, private clonal rubber plantations are quite new. Preliminary introduction has been made in the 1930's with clonal seedlings ("karet lambau") but does not lead to a full adoption by local farmers.

The first large scale project started in the Sanggau area in the 80's with SRAP, although some clones or selected seedlings had been introduced in the 50's (by missionaries or research institutes). However, they rapidly adopted the clonal monoculture system and understood its advantages, at least in term of rubber production (resistance to disease or rapid growth still remained partially unknown, as well as differences between clones).

The results of the SRADP budwood garden show great differences between the villages. Sanjan and Pariban Baru are highly successful, whereas Embaong is on the way to succeed, and Kopar and Engkayu still face uncertainty about their choice between oilpalm and clonal rubber to be developed on a large scale.

Sanjan: a very innovative village

In Sanjan farmers have already used clonal rubber for more than 15 years through the SRDP project. A very strict organisation and a strong social cohesion lead to the success contrary to Sungei Kosak at the same period. Rubber clonal plantations are highly productive, although the choice of GT1, very susceptible to *Colletotrichum*, has been a mistake[5]. When the SRAP project started in the area in 1993, farmers were sufficiently aware of the clonal rubber planting requirements. According to the fact that they already joined the SRDP project, there was no demand for SRAP Rubber Agroforestry Systems (RAS). However they expressed their interest in budwood garden, their main constraint being access to IGPM. Farmers in Sanjan are the most innovative farmers of all the area. Thus they created 5 farm groups (kelompok) of a dozen of farmers who manage their own community rootstock nursery. In 1997 the 5 farm groups still exist, and have obviously the same strategy for the village development. Concurrence between farm groups leads to emulation and contributes to increase the level of adoption of innovations. Furthermore, today farmers of Sanjan do not intend to follow the surrounding oil palm projects that approached them, rubber plantations being their priority choice. Among all the SRAP budwood gardens, only Sanjan's one has been used since now (1997).

[5] GT1 has an average yield of 1600 kg/ha in other provinces without *Colletotrihum.* In West Kalimantan, GT1 yields between 1000 and 1200 kg/ha of dry rubber.

Pariban Baru:

In Pariban Baru, few Dayaks, among other Javanese transmigrants in a foodcrop-based transmigration pattern, joined the PKR-GK rubber project in 1993 (a GAPKINDO/DISBUN partial approach project). The two communities seldom mix up. Dayak farmers joined SRAP in 1994. In 1996, they were provided with a budwood garden after discussions with farmers who expressed a strong demand for IGPM due to certain remoteness (they are 14 km far from the main road Sanggau-Sintang). Those farmers have developed a very strong solidarity under the authority of the group's leader and are not interested in the oil palm project. They put therefore a lot of attention and great hopes in their clonal rubber plantations to improve their income. A group's rootstock nursery has been established and grafted in 1997. In that case, the strong social climax and cohesion of the farmers group was a key factor in IGPM self-production and quick adoption of innovations. Similarly to Sanjan, but in a completely different environment, these Dayak farmers are also very innovative in 1) rehabilitating *Imperata* savannah through clonal rubber plantations and 2) developing agroforestry practices in rebuilding biodiversity in rubber plantations with fruit and timber trees to diversify production but also seed production and intercrops.

Embaong: Sanjan' success triggered their interest

The village of Embaong was originally reluctant to join SRDP in 1983 due to the fear to invest into new activities. In the same time Sanjan farmers already immediately joined SRDP. This triggered those of Embaong to adopt the SRDP project in 1987. In 1996 they joined the SRAP on farm experimentation network. But many farmers consider they now earn enough capital from their rubber plantations and work in the oil palm projects in the area. Thus their strategy is to buy clonal stumps rather than investing time and labour in producing them. Again, Sanjan ‘s example and their success in IGPM self-production with SRAP budwood garden inspired Embaong’s farmers and boosted their motivation to manage a community budwood garden, established in 1996. Maintenance relying on group work, many farmers try to avoid the task. In 1997 these cohesion and solidarity problems still prevented farmers to take care of the budwood garden. In August, considering the success of Sanjan, the group began to reconsider its policy and gave more attention to the budwood garden. Embaong is a good example of a village with slow adoption of innovations as long as they have not yet seen the results.

Kopar: a slow but efficient integration of new agricultural technique

Kopar has followed a similar path as that of Embaong with the difference that there is no SRDP plot. Their very strong attachment to ancient agricultural traditions has been a problem for adopting new technologies. There is no SRDP project in that village and local farmers have the feeling that they have missed opportunities in the past and do not want to miss them again, explaining their interest in RAS as well as for oil palm project. First experience with SFDP in 1992-94 shows also a certain reluctance in modifying cultural practices that prove to be sustainable but an obvious interest was present in order not to miss again a

potential opportunity, at least by some farmers in a relatively innovative group compared to the rest of the village.

Gradually, with the introduction of RAS technology in 1994-97, farmers integrated slowly but surely innovations. They recently decided to join in mass an oil palm project. Concerning the budwood garden, farmers keep interest in planting clonal rubber in order to diversify their cropping system but labour will probably be focused on oil palm. RAS requiring moderate labour will probably suit better their strategy. They also have a large area of old jungle rubber to replant with clones. This should sustain intend in IGPM production in the next future. But is appears clearly that the lack of agreement between farmers groups has been a constraint in the innovation adoption process. The social conflict on how to manage the future of the village and the disagreement on possible participation to any projects has been a serious hindrance, restricting the interest of farmers for the budwood garden experience.

Engkayu

Farmers of Engkayu first remained also very attached to their traditional cropping systems, and were reluctant to adopt innovations brought by projects. However, their proximity with the town of Pusat Damai favoured exchange of information, access to potential markets and accelerated the process of adoption of some innovations such as the use of clones of Glyphosate against Imperata. When SRAP proposed a budwood garden to farmers 1,5 year after implemented off farm trials (OFT), they welcomed the programme. But in the same time they accepted to join an oil palm project although land is becoming scarce as they have to provide 7.5 ha for the company when the company return only 2 ha with plantation to the farmers. The actual loss of land is therefore of 5 ha per family. Actually , the current situation in Engkayu is now very confused, and two groups coexist. The first one would like to go on with rubber plantations using clones (without losing land), the other would prefer to join oil palm project (with a loss of land but a full credit for the plantation). The village leader being unable to choose between the two alternatives, the village community has no more social cohesion and social problems occur through the concurrence between farm groups (social unbalance). To date, only one farmer built his own rubber rootstock nursery. In that case, the social conflict within the community is also clearly a constraint to innovation adoption.

Conclusion on survey II

In the case of the 2 Javanese villages, Sukamulia and Trimulia, IGPM production is aimed for trade and partially for plantation establishment (in Trimulia but not in Sukamulia). We see here the beginning of a process of specialisation (nursery activity) and it shows that the same activity, IGPM production may lead to 2 different strategies: self-production for further planting (Trimulia) or specialisation in nursery for trade (Sukamulia).

In traditional Dayak villages, the success of the village budwood garden programme is not depending on technical constraints nor on economic ones, but on

the community social cohesion, in particular on equity, balance and agreements between farmers groups and consensus on development strategy at the village level.

Off farm activities and productive sawah are restricting interest in IGPM production. The recent development of oil palm provides a new interesting opportunity for farmers as far as credit is provided in the technological package. This new crop opportunity may also decrease intend in IGPM production. However, in many situations, IGPM production at low cost and of high quality should provide the opportunity to replace old jungle rubber and rely on productive improved rubber systems (with RAS or monoculture) with a return to labour and income level very comparable to that of oil palm [Penot, 1997 #34].

The difference between oil palm and rubber system stays in two points: 1) the mature period of rubber is 5/6 years in West Kalimantan (3 years for oil palm), 2) there is no credit available for rubber system. However, the flexibility of rubber system, the long term estimated demand on rubber and its high potential in agroforestry systems, traditionally favoured by local Dayak farmers, are very strong incentive for developing rubber plantations with high quality IGPM. Finally, clonal purity is essential to guarantee to farmers a high productivity and a full adaptation to local conditions (varieties that resist to *Colletotrichum*).

Use of IGPM in the SRDP-TCSDP monoculture plots in Sanjan (Survey III)

The SRDP project in Sanjan

The SRDP project started in 1980-81, and a second stage was initiated in 1989-90 with the TCSDP project (same monoculture technological package). With these projects, farmers were provided with clonal rubber plants (GT 1, susceptible to *Colletotrichum*, and later PB 260), fertilisers, pesticides and cash money for some terracing. Almost all the farmers also own plots of jungle rubber besides their clonal monoculture plots (10 farmers out of 14), and this experience and the perception they have of agroforestry systems induced important changes in their strategy concerning monoculture.

The conception of monoculture in Sanjan

Monoculture still remains the system promoted by official institutions in Indonesia. The technical monoculture package is kept on institutions' advice, and evolution to agroforestry system is forbidden, although no evidence has been made of the superiority of monoculture over other systems. However, 33% of the farmers in Sanjan changed their SRDP plot into agroforestry systems, at different intensity levels.

Farmers who think monoculture is not the most adapted system are almost threefold the number of those who are satisfied (11 Vs 3 who are pleased with the monoculture system). One farmers considers that monoculture is not adapted to smallholder's farming conditions (chart 2), and should be used for estates only.

Even farmers who are satisfied with the monoculture system face several problems:

- rubber leaf diseases for 12 of them,
- root disease and
- weeds, in particular *Imperata cylindrica (Alang-alang)*, increasing with the light from defoliation induced by *Colletotrichum*.

And only 30% think that monoculture is better than agroforestry systems in term of production (chart1).

Monoculture or agroforestry systems: institutions Vs tradition

Official institutions still stick to monoculture (chart 4) for they advise that mixing rubber trees with other crops may decrease the rubber yield by lack of light and too much root competition. But to date, there is no evidence of such interaction on rubber productivity in agroforestry systems. Comparable yields with unselected seedlings in jungle rubber and in monoculture suggest the opposite. However, it is still questionable depending on the number and type of associated trees. Disbun also evokes the risk of diseases (chart6), the SFDP the fact that rubber trees will be cut at the end of the rubber production (35 years) and the other trees will not be old enough to be a sufficient source of income, in particular for timber trees. But with rubber agroforestry systems technology, you may decide to keep your plot with fruit and timber trees after rubber's life span.

In Sanjan, obviously, monoculture is not perceived as the best system for smallholders, even for clonal plantations. Globally, farmers dislike being dependent from rubber production only, and would like to earn income from other productions (timber and fruits essentially). Their agroforestry systems fit their strategy of diversification of income sources(chart 3). Every farmer thinks that associating trees with rubber is feasible. Only one nevertheless chose to stick to monoculture.

Fruit trees Vs timber trees: the choice of a mid-term strategy

The agroforestry systems developed in Sanjan are mainly based on perennials (fruit trees and timber trees), and incomes from associated trees is the main motivation (only one farmer consider the mixing of rubber with timber trees as a way to prevent *Imperata*). Only one farmer out of 14 already planted annual crops as an intercrop in his clonal rubber plantation. 11 farmers planted fruit trees, and 10 timber trees (chart 7). But fruit trees outnumber timber trees in term of plants effectively planted in the plots. Farmers are far more interested in fruit trees than timber trees due to the shorter fruit production compared to timber output (5 to 8 years for fruit trees, 35 to 50 years after planting).

Planting strategies differ between fruit and timber trees. Emphasis being put on fruit trees, farmers do not want to rely on natural regeneration (3 farmers only), and fruit trees are generally planted (10 farmers) (table 16 & 17). For timber trees, half of the farmers (7) allows selective natural regeneration (chart 8). Generally, farmers who plant fruit trees also allow natural regeneration (chart

10) for both kind (timber and fruit trees), but those who plant timber trees do not allow natural regeneration for timber trees (chart 9, table 14 & 15). The strategy to plant or let grown timber trees is induced by the ban on private timber cutting for sales all over Indonesia. Growing timber in the SRDP plot is perceived as a way to increase timber outputs besides those from tembawang (chart 11).

The main motivation for planting or growing timber trees is to assure their children of a valuable source of income on the long term. All the farmers underestimate the time before timber production (average of 30 compared to an actual time of 50-80 years), and time for fruit production is more accurately known (chart 12).

In term of density recommended for associated trees, farmers have very different views (range of density recommended from 50 to 250 trees/ha, chart 13) & table 11. Traditional knowledge from tembawang and jungle rubber cultivation pushes farmers to state an average of 150 associated trees as an optimum (table 12). The actual average density is relatively high (average of 200 trees/ha). That weakens the Disbun's recommendation not to mix associated trees with rubber trees. Table 13 displays trees that are not recommended as intercrop with rubber.

Table 11. **Densities recommended by farmers for associated trees**

Recommended densities (trees /ha) / Number of farmers			
30	1	100	1
40	1	150	4
75	1	250	2

Table 12. **Actual densities in the SRDP plots**

Actual densities (trees /ha) / Nb of farmers			
50 > 100	1	200 > 250	1
100 > 150	5	> 250	2
150 > 200	5		

Table 13. **Trees whose plantation is not advised by farmers**

Trees whose plantation is not advised by farmers							
Type of tree		Nb of farmers		Type of tree		Nb of farmers	
Tengkawang	AB	8	57 %	Keladan	AB	1	7 %
Mentawa	AF	4	30 %	Meranti	AB	1	7 %
Nyatoh	AB	2	14 %	Jengkol	AF	1	7 %

Table 14. **Types of timber trees in the SRDP plots**

Type of tree	Number of plots		Average number of trees /plot
Medang	11	85 %[6]	9
Nyatoh	9	69 %	4
Tengkawang	7	54 %	3
Keladan	3	23 %	2
Omang	3	23 %	1

Table 15. **Timber trees whose plantation is advised by farmers**

Type of tree	Number of farmers	
Keladan	9	64 %
Belian	8	57 %
Meranti	7	50 %
Tekam	4	29 %
Nyatoh	1	7 %
Tengkawang	1	7 %

[6] % calculated with the actual number of farmers having timber trees (13 farmers).

Table 16. **Types of fruit trees in the SRDP plots**

Type of tree	Number of plots		Average number of trees/plot
Pekawai	14	100 %	13
Durian	14	100 %	9
Rambutan	14	100 %	5
Cempedah	9	64 %	4
Mentawa	9	64 %	4
Petai	8	57 %	4
Langsat	5	36 %	2
Jengkol	4	29 %	7
Mangousteen	4	29 %	3
Jambu	3	21 %	2
Cocoa	2	14 %	32
Blimbing	2	14 %	2
Rambai	1	7 %	3
Coffee	1	7 %	3
Mango	1	7 %	1

Table 17. **Fruit trees whose plantation is advised by farmers**

Type of tree	Number of farmers	
Durian	9	64 %
Petai	9	64 %
Langsat	9	64 %
Rambutan	4	29 %
Jengkol	4	29 %
Coffee	1	7 %

The future: to develop the agroforestry systems based on fruit trees

The actual tendency will be going on in the next few years, since farmers are all pleased with the actual agroforestry systems. Farmers who already transformed their monoculture plot intend to plant more trees than currently done, in particular fruit trees. Timber trees will be planted by 50% of the farmers only, and are those who generally have some in their plots. Besides these farmers, 50% of the others, who since now have still maintained the monoculture, intend to transform their plot in the next 2 years (chart 14). That shows that agroforestry practices

where perennials are combined with rubber are a main feature of rubber farming practices in that village.

Pulp trees: no incentive and no market

Currently, farmer's knowledge about pulp trees is very thin. Only 4 farmers know that they have the right to sell pulp trees (chart 15 & 16 & 17). To date none has planted pulp trees, and only three farmers are ready to grow such trees. Projects about pulp trees are relatively new in this part of Kalimantan. There is still no factory in the area. For this reason, few farmers intend to invest in this activity which is not yet developed and does not provide a guarantee of marketing. Pulp trees are more perceived as a way to prevent *Imperata* growth than a source of income, since they would not be planted with a high density in SRDP plots. In 1997, a factory shall be built before 2001, but the economic slowdown that struck Indonesia in 1998 will delay this project for some long time.

Conclusion on survey 3

Farmers of Sanjan are the most innovative of the area. They joined in mass the SRDP project in 1981. After few years, due to the perception they have of rubber plantations, they transformed their rubber monoculture plantations by associating fruit and/or timber trees, although it has always been prohibited by SRDP. They clearly have a short term strategy and planted more fruit trees than timber trees. Some farmers allow the regeneration for timber trees. Products of these associated trees are essentially for self-consumption or local sales (fruits). No farmer already plant pulp trees and few of them have knowledge about pulp trees production and marketing. Their planting strategy still remains based on clonal rubber plantations, and no farmer would like to join oil palm projects (survey II). Few of them is ready to try pulp trees, but they are still waiting for this activity to be developed.

Final Conclusion

The current improved rubber planting material commodity system is suffering from 2 major constraints: the inertia of extension services in developing, with the private sector, a network of nurseries and the global very bad quality (in term of clonal purity) of the planting material, provided at each level (except notably for SRDP and TCSDP).

The improvement of the situation is based on the following topics:

- the certification of the planting material production for all operators
- the verification and rehabilitation of all existing budwood gardens and nurseries in order to improve immediately the network
- the creation of “genuine” farmers association in order to improve access to information, to guarantee the certification process and provide a better services to farmers through links with the private sector of nurseries.
- a better technical information on clones use, clonal recommendations and cultural practices for monoculture and RAS.

- There is a real farmers' demand for good quality clonal planting material.

It seems clear also that the extension message, currently focused on pure mono-culture, should be changed and opened to RAS or other agroforestry practices in order to follow the farmers' endogenous trend to plant associated trees with clones.

Associated tree distribution per plot (Sanjan, village), Re introduction of associated trees in former rubber monoculture plots

				Plots														
Type of tree		Use	other use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
pekawai	Durio kutejensis or dulcis	AF		4	6	31	6	11	6	10	6	39	1	3	8	5	48	184
durian	Durio zibethinus	AF	m.b.	4	1	17	5	1	5	18	20	2	4	9	1	30	9	126
Belian	Eusideroxylon zwageri	AB	m.r.b.h.	1	5	29	1	3			12	14	4		10	9	12	100
rambutan	Nephelium lappaceum	AF	m.b.	2	7	3	4	13	7	7	5	3	7	4	4	1	9	76
cacao	Theobroma cacao	AF					50	14										64
asam	miscellanous "es of mango	AF	m.b.	2	6	6		1	14		5	4		1		3	2	44
cempedak	Artocarpus integer	AF	m.b.		8			1	4	3	7		1		1	6	4	35
mentawa	Artocarpus anysophyllus	AF			2			1			1	1	1	4	5	3	14	32
petal	Parkia spp	AB	m.b.	3	2	7	2	8						1		1	8	32
nyatoh	Palaqium spp	AF	r.		13	5			1		8	1	1	1	1		1	32
jengkol	Archidendron pauciflorum	AB	m.b.	5		5						2				14		26
keladan	Dryobalanops beccarii	AB	m.r.h.f.	17										1			5	23
omang	Hopes dryobalanoides	AB		3								15					4	22
tengkawang	Shorea spp macrophylla	AT	m.r.h.		6			2			1		1	2	1		3	16
langsat	Lansium domesticurn	AF	m.b.										3	5	3	1	2	12
mangousta	Garcinia mangostana	AF	m.r.b.		2								2	3			2	10
jambu	Eugenia spp	AF	m.b.					4						1				7
blimbing	Baccaurea angulata	AF		1						2								3
rambai	Baccaurea motleyana	AF	m.r.b.		3													3
coffee	Coffee canephora	AF	m.h.				3											3
terindale	Dimocarpus longan spp	AF						2										2
mlinjo	Gnetum Gnemom	AF		1														1

			Plots														
Type of tree	Use	other use	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
mango Mangifera indica		m.b.															1
other AA								1		1		10	5	20		27	63
other timber			1							24	3	2		10	3		43
Total			44	61	103	71	61	38	40	90	84	38	40	64	76	150	960
rubber			235	215	182	122	190	154	130	292	212	184	197	260	160	450	2983
																	Moy
Rubber trees/total Number ratio			5,3	3,5	1.7	1.7	3.1	4	3.2	3.2	2,5	4,8	4.9	4	2.1	3	3,4
Number of rubber trees/ha			500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Number of associated trees/ha			94	142	283	291	161	123	154	154	1	103	102	123	238	167	167

Source: Economic plants of Indonesia, ORSTOM, 1991

This table has been revised by J.M. Bombard. Thanks to him.

The name of the trees might be Malayu, Javanese or local (Dayak).

Use = main use of the tree (according to H de Foresta and P Levang, ORSTOM).

AF = f = FRUIT TREES
AB = b = TIMBER
m = médicinal PLANTS
r = résins
h = oil