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RUBBER AGROFORESTRY SYSTEMS POTENTIAL DEVELOPMENT IN THAILAND through the SRAP/INCO/EU funding proposal

Preliminary mission in Thailand,
20 to 26th of May 1997

Eric Penot
CIRAD-CP/ICRAF

CP 807
June 1997

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Dr Anan Vattanatangum,
Rubber Research Institute of Thailand (RRIT), director.

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INTRODUCTION to THE SRAP project (Smallholder Rubber Agroforestry Project) and the INCO/EU funding proposal

SRAP is an adaptive research project initiated in Indonesia since 1994 by CIRAD-CP (tree crop division, rubber programme) , GAPKINDO (Rubber Association of Indonesia) and ICRAF (International Center for Research in Agroforestry), aimed to improve productivity of rubber based complex agroforestry systems in Indonesia conserving the benefits of agroforestry practices in terms of biodiversity conservation and environmental sustainability, in particular in soil and water conservation. Publications and report available on the project objectives and achievements are in annex 1. A network of 100 fields for on-farm experimentation with participatory approach has been developed in 3 provinces in Sumatra and Kalimantan (27 trials with 3 to 5 replications) as well as 12 rubber budwood gardens in order to study the constraints of rubber planting material production by smallholders themselves. The socio-economic programme is aimed to farming systems characterization , to the identification of an operational typology and to the study of adoption innovation process through various socio-economical and ethnical situations..

Main SRAP Objectives for 1997-2000

There are the following :

- 1 - monitoring of the current RAS (Rubber Agroforestry Systems) on farm trials network in the 3 provinces in Indonesia (data collection and analysis). The network is composed of 27 trials with 100 farmers, 2 agricultural schools and 12 budwood gardens.
This OFT (On farm trials) network is going to produce relevant data and information on RAS technologies and technical recommendations. The network has been set up between January 1995 and december 1996.

- 2 - implementation of new trials aimed on rubber + timber + pulp trees in Indonesia and in Thailand with adaptation to local conditions.
Protocols have to be defined, based on the current information and knowledge from RAS experimentation in Indonesia.

- 3 - Introduction of RAS technology in South-Thailand through on farm experimentation with adaptation of the current RAS technology to local conditions.
Establishment of a on-farm trial network.

- 4 - in depth study of some selective agronomical components (root competition, nutrient cycling, light competition in all RAS systems , biodiversity in RAS 1 system....).

- 5 - monitoring of clonal rubber planting material used by farmers from SRAP community budwood gardens.

- 6 - in depth socio-economical study of the "reference farms network". Emphasis on innovation adoption process . Establishment of a reference farms network in Thailand.

- 7 - the study of policy issues : RAS technology adoption constraints at large scale in development schemes through partial approach, planting material supply, land/tree tenure, timber rights...

Objectives 1, 2, 5, 6 and 7 will be directly implemented by SRAP staff. Objectives 4,5, 6, and 7 may be implemented by associated students. Objective 3 will be directly implemented by the Thai partner.

SRAP is currently funded by USAID up to September 1997. A project funding proposal is currently being developed to be submitted to INCO/EU for September 1997.
INCO requires 2 Europeans partners (CIRAD/France and Finland) and 2 Southeast Asian partners: Indonesia and Thailand.

The objective of this mission is to identify the partners in Thailand after preliminary contacts and the relevance of developing SRAP in Southern Thailand.

PARTNERS

EUROPEAN PARTNERS

The main partner is CIRAD-CP, submitting the proposal to EU.
(ICRAF and CIRAD are already partners on SRAP project since 1994: the partnership goes on the same base).
The other European partner will be the University of Helsinki (UH) Tropical Sylviculture, Finland.
This partner will provide its knowledge and experience on timber and pulp trees production. THE university has also an agreement with ENSO, a semi governmental development agency which has pulp production project in Kalimantan, in particular in one of the province selected for SRAP activities (West-Kalimantan).

PARTNERS IN SOUTHEAST ASIA

However SRAP is originally a CIRAD/GAPKINDO/ICRAF project, ICRAF is not directly eligible for EU but may be considered as a non fundable local partner in association with GAPKINDO and IRRI/BPS (Indonesian Rubber Research Institute/Research station of Sembawa, South Sumatra) . CIRAD, GAPKINDO, IRRI and ICRAF will be the main implementing agency through the "Indonesian consortium".

Therefore, the 2 partners in Southeast Asia are:

- the current consortium GAPKINDO/CIRAD/IRRI-Sembawa/ICRAF: which is implementing the project in Indonesia.

- the Thai consortium with :
    - the Prince of Songkla University in South-Thailand.
    - the Kasetsart University/Faculty of Forestry -Bangkok) , as University of Helsinki has already develop jointed activities with them (in particular for the timber component in Thailand).

CURRENT CONTACTS

EUROPE

CIRAD-CP

Eric Penot is leading the PCRD/INCO proposal. Dominique Laurent from CIRAD-CP will help in refining the proposal to the EU standard (standard CIRAD procedure to improve proposals and adoption rate). CIRAD-Forêts with Mr L. Mallet (in charge of agroforestry at CIRAD) may also be involved in the project proposal. Associated scientists are Mr Delabarre and Mr Eschbach from CIRAD-CP.
The contribution from CIRAD will be a full time scientist (Mr Jobbe-Duval) based in Bogor, part time scientist missions (from France) and full technical support.

University of Helsinki (UH)

Mr Jusi Kuusipalo, from ENSO South Kalimantan; will help us to develop a partnership with the UH/UJ with Dr Vesa Kaarakkan. Locally in Kalimantan, the work can be implemented with Riika Otsamo, based in Sanggau, West-Kalimantan.
The contribution from UH/UKJ will be through technical support missions to the project from the professor leading the research for timber component (based in Helsinki).
UH/UJ has already an agreement with ENSO. ENSO can be the implementing collaborative agency for the timber component. Contacts at ENSO are Dr Jussi Kuusipalo and Mr Goran Adjers, currently in South-Kalimantan.
UH/UJ has also contact with Kasetsart University (Bangkok)
So far, Dr Vesa Kaarakkan and Riika Otsamo will the main scientists involved in the project activities.

ASIA

INDONESIA

GAPKINDO/BPS/ICRAF/CIRAD

Mr Benoit Jobbe-Duval, CIRAD-CP, Rubber programme, seconded to ICRAF (a proposal at that stage). Team leader
Dr Gede Wibawa (BPS (seconded to ICRAF), lead scientist in Indonesia, agronomy
Dr Hisar Bihombing (BPS), soil scientist
Dr Budiman (GAPKINDO), planting material and rubber quality
Dr Dennis Gariity (ICRAF), agronomy
Jim Roschentko (ICRAF), associated trees germplasm,

THAILAND

University of Songkla

Dr Pramoth., lead scientist in Thailand, agronomy
Dr Somboon Charoenjiratrakul, socio-economy
Dr Suchyana, geography.

RRIT, Hat Yai

Dr Sompong Kongsripun,

Kasetsart University (Bangkok)

Dr Suree, international cooperation with local partners.
Dr Damrong, forestry

BUDGET
800 000 ECU on the basis of share costs.

PROJECT DURATION
3 years

1 BANGKOK: VISIT TO KASETSART UNIVERSITY/FACULTY OF FORESTRY, Bangkok.

Meeting with
- Dr Suree Bhumibhamon, vice president for International Affairs (KU/FF)
- Dr Damrong Pipatwanattanakul (KU/FF)
- Dr Regis Iacote, CIRAD-CP, rubber programme.
- Dr David Thomas, ICRAF/Thailand.
- Dr Yves Crozat, DORAS project team leader, CIRAD-CA

The contacts in Kasetsart University/Faculty of Forestry (KU/FF) has been provided by Dr Vesa Kaarakka, from University of Helsinki (UH). Cooperation between Finland and KU/FFis existing since 1968. It appears that D. Thomas, ICRAF representative (based in Chiang Mai) knows also very well Dr Suree.

The objective of this preliminary contacts was to see if KU/GFF was interested to participate to the INCO/EU SRAP proposal. The meeting has been very positive and Dr Suree agreed and strongly support a cooperation with CIRAD and ICRAF on SRAP as well as with Prince of Songkla University/Faculty of Natural resources (PSU/FNR). Dr Damrong will implement 2 missions per year to PDU/FNR in Hat Yai for technical support , in particular in the identification of the fruit and timber components of RAS (Rubber Agroforestry Systems).

Dr Suree is very keen to develop international cooperation as it is already the case with the DORAS project (with the presence of Yves Crozat who attended the meeting).

2 VISIT TO PRINCE OF SONGKLA UNIVERSITY/FACULTY OF NATURAL RESOURCES, HAT YAI.

Meeting with
Dr Somkiat Saithanoo, dean of the Faculty, and
Dr Chutima Tantikitti, vice dean

as well as the scientists interested in further SRAP research programme implementation in Southern Thailand:
Dr Pramoth Kheowvongsri, agronomist
Dr Somboon Charernjiratragul, socio-economist
Dr Suchyana Boonwanno, geography.

The dean is also very keen to develop again cooperation with CIRAD. CIRAD used to work with PSU in the 80's (with Guy Trebuil and Y Crozat, in particular) leading to a very good understanding and cooperation between the two institutions.

The team will be composed of the 3 scientists, mentioned above , that have been all graduated for PhD in France. the topic of their PhD thesis were for all of them agroforestry systems in Thailand. There have a very good knowledge of existing systems and the complementary background for a multidisciplinary approach.

RRIT in Hat Yai has developed since ten years a research programme on rubber based agroforestry combining rubber with timber and fruit trees species, very comparable to that of SRAP. 30 demo plots have been established in the area. SRAP can build on its on farm experimentation on this preliminary experience and results (see in annex the latest publication).
Mr Sompong Kongsripun will also contribute toi SRAP activities with the PSU team.

On farm experimentation methodology

The main objective in southern Thailand not to increase the productivity through the integration of clonal rubber as clonal rubber is already widespread amongst smallholders since at least 20 years but income diversification, with timber and fruit production beside rubber, as well as the environmental benefits of agroforestry in terms of soil conservation at the plot level but also at the watershed level. Environmental concern has grown before the high rate of deforestation and the increase of landslides and problems at watershed level.
SRAP can test some hypothesis through On-Farm Trials (OFT) with high yielding rubber clones associated to timber and fruit species on the base of RAS 2 type (with intercropping during the first 3 years of immature rubber period). There is obviously a market for both fruits and timber, especially for good quality fast growing timber fro furniture or carvings. It seems that there is apparently no markets for pulp trees.

It should be noted that the rubber development policy currently implemented by ORRAF is very incentive for rubber planting with a free credit of 6800 bath per hectare (272 US $) given to any smallholder who wants to plant clonal rubber. this subsidy pay off entirely the cost of clonal rubber planting material, the most important in a rubber plot establishment. All farmers have therefore very easily adopted rubber monoculture. Thailand has 1.7 million ha of rubber planting, mainly in the southern part of the country

(60 000 ha have been recently planted in the northeast area). That explains why farmers do not tap anymore old jungle rubber and shift to clonal rubber monoculture. Existing old jungle rubber stays as secondary forest plots scattered in the landscape, waiting for further planting with rubber in monoculture.
Since 5 years ORRAF and RRIT (1991) are very in favour of perennial intercropping of fruit and timber trees with rubber leading to a very easy adoption of agroforestry practices in the south. Currently farmers begin to grow mangostan, Parkia, Longkong, Durian and Rambutan in their originally monoculture rubber plots. One can find in appendix the latest up to date publications on rubber agroforestry research from RRIT.
The environment, both institutionally and ecologically is very favourable to the development of agroforestry practices based not only on food intercropping during immature period but also to fruit/timber/rubber association in complex agroforestry systems.
The on farm trials will be developed with 5-6 trials with 4/5 replications each, with rubber monoculture as a control in all trials. All OFT are with participatory approach with farmers.

FIELD VISIT IN HAT YAI AREA

Rubber is generally planted at lower planting density than that of Indonesia: 7 x 3 (474 trees/ha) and in certain plots 2.5 x 10 (400 trees/ha) with large spacing to enable fruit or timber trees to grow. farmers used in vast majority RRIM 600 however, very recently some other clones have been introduced such as BPM 24. Some Thai clone such as KRS 24 are used at small scale.
One can, remark that the rubber commodity system in Thailand is only almost relying on 1 clone, RRIM 600, a very dangerous situation in case of major disease strike.
However, the policy of use of clonal rubber at large scale has been successful, there is also a problem of planting material availability in Thailand not in term of quantity (or real availability at farm level) but in terms of quality (clonal diversification) with the necessity to introduce more clone such as PB 260, RRIC 100, BPM 1 and 24, GT 1.... in order to diversity the rubber clonal germplasm.
The average production is between 1200 and 1300 kg/ha/year (100 % DRC). Opening occurs generally at the 7th year. 95 % of the rubber produced in Thailand is from smallholding. Clones in estates are generally opened at 5 (PB 260) to 6 years old (GT 1).
It should be noticed that rubber growth is recorded at 1.7 meter AGL during immature and mature period, in opposition with the international standard of 1 meter during immature period and 1.5 during mature period.
All farmers are skilled in grafting, both rubber and fruit trees. tapping is generally if good quality.

The main trees that have been tried with rubber are the following:

TIMBER TREES
- neem tree or "thiem": *Azadirachta excelsa*, timber tree
- "Thang": *Litsea grandis*, timber tree that grows naturally from natural regeneration in rubber fields

- Teak: *Tectonia Grandis*
- mahogany : *Switenia macrophylla*
- "phayom": or white meranti: *Shorea talura*
- "tumsao": *Fragacs fragans*

PULP TREES
- *Acacia mangium*

other "trees":
- rattan: *Calamus caesius* seems to be the most promising.
- coffee (Robusta c)

FRUIT TREES:
- "Salak": *sallaca spp*
- " durian": *Durio zibethinus*
- "longkong": *Lansium domesticum* (or Aglia duku, griff)
- "petai": *Parkia speciosa* (Nita tree)
- "jack fruit": *Artocarpus heterophyllus*
- "cempedak": *Artocarpus Integer*
- "mangoustan": *Garcinia dulcis*
- "banana" *Musa spp*

Intercropping during immature period :

- first 3 years: generally rice/peanut/pineapple/banana/cassava.....
- after 3 years: shading tolerant plants such as ginger, cardamom, "galangol",

Cost of improved grafted planting material

	in baths	in US $
Rubber in polybag:	13 b	0.52
Rubber stump	4 b	0.16
Durian	20 b	0.8
Mangoustan	20 to 40 b	0.8 to 1.6
Cempedak	35 b	1.4
Petai (Parkia)	15 b	0,6

PLOT 1 RRIT DEMO PLOT rubber + neem trees

Photo number 1
Rubber (3 x 7 m)+ neem tree (5 x 7 m). Neem trees have been planted 2 years after rubber.
Rubber growth is recorded every 6 months.
First results are presented in annex 3 (communications from RRIT).

This demo plot is very promising and neem tree should be included in our experiments. Neem tree fits the existing market for fast growing timber trees that can be used for furniture or carving.

As neem tree grow relatively fast, it has been planted 2 years after rubber. At 5 years old, rubber and neem tree canopies are at the same height. Various planting densities should be considered to identify the most adapted to rubber.
There is a timber tree, considered as of very good quality, which is growing from natural vegetation in rubber plantations, "thang" (Litsea grandis, Photo number 3) that also can be combined efficiently in timber + rubber combination.
Teak and mahogany have been tried in station but apparently not in demo plots with farmers. The lifespan of these 2 species is up to 15/20 years as that of thiem and thang is apparently 10 years.
A RAS experiment should consider at least these 4 timber species.

PLOT 2 RRIT DEMO PLOT rubber + longkong

Photo number 2
Rubber (3 x 7 m) + longkong (Langsium domesticum) (9 x 7 m). Longkong have been planted at the same time as rubber.
Rubber growth is recorded every 6 months.

This demo plot is also very promising and should be included in our experiments. Longkong is a different variety that of Duku in Indonesia, but very similar, with an average to slow growth, with a canopy underlying that of rubber. Longkong, like duku, is shadow tolerant. Apparently there is no competition at all with rubber.
Farmers also crop Mangoustan on their own in 15 years clonal rubber plantation.
Photo number 3
One can notice that farmers have a long tradition in fruit trees agroforestry including durian, rambutan, longkong, jengkol, jackfruit, cempedak (a wild variety of jack fruit) and petai (Parkia).
A RAS experiment should consider combinations with these fruit species at different type of combination and different planting density.

PLOT 3 RRIT DEMO PLOT rubber + association of longkong/Cempedak

Photo number 5, 6 & 7
Rubber (3 x 7 m) + longkong (Langsium domesticum) (5 x 7 m) + cempedak (5 x 7 m in alternating with longkong. Longkong and cempedak have been planted at the same time as rubber. The idea here is to maximize soil and space occupation by fruit trees limiting competition factors by combining medium growth/medium size fruit trees (cempedak, comparable to that of rubber) and small size/slow growth fruit tree (longkong).The plot is 5 years old. Opening should occur at the year 7th year after planting.
Rubber growth is recorded every 6 months.
The demo plot is also very promising and there is apparently no competition between fruit trees and rubber, at least for rubber growth during immature period. The field is also planted with banana clusters. Cempedak 5 years after planting is almost as high as big as rubber.
One can notice that there is a lot of Amorphophallus in the field, a relatively rare flower, flowering once every 20 years, with a big white smelling flower.

PLOT 4 RRIT DEMO PLOT rubber (large spacing) + association of longkong/durian/Parkia in banana cluster

Photo number 8, 9, 10, 12
Rubber (2.5 x 10 m, 400 rubber trees /ha) + longkong (Langsium domesticum)/Parkia/Durian at the same place on banana cluster (10 x 5 m). Banana is planted at the same time as rubber. Whene the banana cluster is 1 year old with 5 to 6 developed stems, fruits trees are planted inside the cluster, benefiting from a more adapted microclimate: temperature is fresh and moisture is high. the 3 tress are growing at different rate. Parkia has the fastest growth. Parkia a low shading canopy and, being a leguminous, provide N to other trees.
Durian is grafted (improved durian). is system enable the trees to grow in a very good environment. Complementarily in growth and canopies is evident.
he photo number 12 shows the spacial distribution of canopies 5 years after planting.

PLOT 5 Fruit based agroforestry system with longkong, Cempedak, durian, Parkia, mangoustan.....

Photo number 11
Same system as above but without rubber. Mangoustan is also mixed with other trees as it seems that insects does not like its presence, indirectly protecting the other trees from insect strikes.

Photo number 13: shows traditional intercropping (with pineapple).
Photo number 14 & 15: shows the weed infestation of young plantations in the absence of any intercrops or covercrops, with an insufficient number of associated trees for shading.

DISCUSSION and conclusion

In the Pangha province, there is also a rubber based agroforestry system with old jungle rubber (more than 40 years) that also have been enriched with bamboos, rattan species, and multi-purpose trees (timber + consumption of leaves....) such as "Miang" and Manboo" (no latin names). A better characterization of existing agroforestry systems, more detailed and precise should be implemented in order to select the most adapted plants and to choose those that can be easily adopted by farmers, or easily multiplied. Taking into account indigenous knowledge is a key factor of RAS technology.
This short visit, the existing bibliography and the work of characterization done by the team members (3 PhD thesis) and these demo plots have clearly showed to the group that there is a wide scope of developing RAS systems in the area, profiting from previous experience and local indigenous knowledge.

Preliminary additional characterization surveys may be implemented to increase the knowledge database on agroforestry systems in the area.

The socio economic programme should also develop the following points :

- the identification of the selected area for on farm experimentation,
- the characterization of farming systems (operational typology)
- cost benefit analysis of RAS developed in the area
- study of agroforestry system evolution and impact at the regional level: agrarians systems and watershed level.

The agronomic programme

It is too early to define precisely a research programme but a general frame may be suggested as a base for further definition of the methodology. According to the project INCO funding proposal, around 15 of trials can be planted, therefore an average of 30 of 0.5 hectare each (average size). This leads to the possibility of developing 6 or 7 trials with 4/5 replications each.
There is also obviously a scope for RAS 2 type trials in the area.
The objective of the experimentation is not to improved productivity of existing jungle rubber (as it is the case in Indonesia) as most of farmers grows already clonal rubber with an correct level of productivity in Thailand, but to integrate, first, ***income diversification*** through production of fruits, rattan, and timber beside rubber latex and, later, rubber wood and, second, to ***integrate environmental benefits of agroforestry practices*** in particular in terms of soils and water conservation, reducing risks of land slide and run -off.

We suggest the following names for the on farm trials:

TYPOLOGY OF TRIALS
- RAS 2/T a, b, c..... with T as Timber oriented
- RAS 2/F a, b, c..... with F as Fruit oriented
- RAS 2/F+T a, b ,c with fruits and timber associated trees.
- RAS2/IGPM : IGPM is Improved Genetic Planting Material for clonal trials

RAS 2/XXXXX for other type of trials.

a, b, c..... are different types of trials according to a specific treatment.

All trials will be based on participatory approach with preliminary discussion with farmers about the species to be intercropped with rubber. A minimum of 5 replication for each trial. So:
1 trial = 4 or 5 replications = 4 or 5 different fields with different farmers.

All replications have several plots according to treatments. The minimum size for a plot should be 1 000 m² (47 trees) with growth and production record on 30 trees per plot excluding external borders.
All fields have a control which is rubber monoculture as traditionally grown in the area.
Rubber will be planted at the traditional planting density of 3 x 7m = 474 trees/ha
Species and planting density of associated trees are according to the treatments.

SUGGESTED PRELIMINARY POTENTIAL RESEARCH PROGRAMME

The methodology can be divided into the following topics :

- A - **types of combination** of rubber/associated trees: with timber trees, with fruit trees or with both timber and fruit trees. Research on competition: below ground (root, water and nutrient competition) and above ground:
- B - **optimization of planting densities** of rubber and associated trees
- C - **amount of fertilization** for both rubber and associated trees. Optimization of trees growth and soil fertility rebuilding.
- D - type of **intercrops or covercrops during immature period:** anti erosion strategy ; Anti Imperata strategy ; sloppy land rehabilitation
- E - **Clonal rubber trial** in RAS 2 environment.

We can see the following promising possibilities in term of trials:
- A - **types of combination** of rubber/associated trees: with timber trees, with fruit trees or with both timber and fruit trees.

TRIAL N° 1
RAS 2/T a: comparison of timber species at a given supposed optimum planting density.

The treatment is on the timber species:
PLOTS
1 rubber monoculture = control
2 rubber + neem trees (5 x7 m)
3 rubber + teak (? x ? m)
4 rubber + mahogany (? x ? m)
5 rubber + neem trees + teak.
Field size: 5 000 m²
Objective: comparison between tree species and inter-actions on rubber growth and production.

TRIAL N° 2
RAS 2/F a: comparison of fruit species at a given supposed optimum planting density.

The treatment is on the fruit species:
PLOTS
1 rubber monoculture = control
2 rubber + cempedak/jackfruit (12 x 7 m) + longkong (12 x7 m)
3 rubber + banana cluster + mix of durian/petai/longkong (6 x 7 m)
4 rubber + cempedak/jackfuit (6 x 7 m)
5 rubber + longkong (6 x 7 m)
6 rubber + petai (6 x 7 m)
Field size: 6 000 m²

Objective: comparison between tree species and inter-actions on rubber growth and production.

TRIAL N° 3

RAS 2/F+T a : comparison of fruit and timber species at a given supposed optimum planting density.

The treatment is on the fruit/timber species :

PLOTS

1 rubber monoculture = control

2 rubber + cempedak/jackfruit (12 x 7 m) + longkong (12 x7 m) + neem trees (6 x 7 m) = 238 timber trees/ha + 238 fruit trees/ha (119 cempedak/jackfruit + 119 longkong/ha = 1 tree every 3 meters on the associated tree row.

3 rubber + banana cluster + mix of durian/petai/longkong (6 x 7 m) + neem trees (6 x 7 m) = 238 timber trees/ha + 238 locations/ha fruit trees/ha (714 fruit trees/ha) = 1 tree every 3 meters on the associated tree row.

4 rubber + cempedak/jackfuit (6 x 7 m) + neem trees (6 x 7 m) = 238 timber trees/ha + 238 fruit trees/ha) = 1 tree every 3 meters on the associated tree row.

5 rubber + longkong (6 x 7 m) + neem trees (6 x 7 m) = 238 timber trees/ha + 238 fruit trees/ha) = 1 tree every 3 meters on the associated tree row.

6 rubber + petai (6 x 7 m) + neem trees (6 x 7 m) = 238 timber trees/ha + 238 fruit trees/ha) = 1 tree every 3 meters on the associated tree row.

Field size : 6 000 m²

Objective : comparison between tree species at high density with mix of timber and fruit trees and inter-actions on rubber growth and production.

- B - **optimization of planting densities** of rubber and associated trees

TRIAL N°4

RAS 2/T b : comparison of planting density for given timber species

The treatment is on planting density for 3 cases :

PLOTS

1 rubber monoculture = control

2 rubber + neem trees (3 x7 m = 476/ha)

3 rubber + neem trees (6 x 7 m = 238/ha)

4 rubber + teak (4 x 7 m : 357 /ha)

5 rubber + teak (8 x 7 m = 178 /ha

6 rubber +.neem trees (6 x 7 m = 238 trees/ha) + teak (6 x 7 m = 238 trees/ha)

Field size : 6 000 m²

Objective : comparison between planting density for 3 cases : neem tree only/teak only/mix teak+neem tree and inter-actions on rubber growth and production.

TRIAL N°5

RAS 2/F b : comparison of planting density for given fruit species

The treatment is on planting density :

PLOTS

1 rubber monoculture = control

2 rubber + banana cluster + mix of durian/petai/longkong (4 x 7 m = 357 locations = 1071 trees/ha)

3 rubber + banana cluster + mix of durian/petai/longkong (8 x 7 m = 178 locations = 535 trees/ha)
4 rubber + cempedak/jackfruit (6 x 7 m) + longkong (6 x7 m) = 476 trees/ha
5 rubber + cempedak/jackfruit (12 x 7 m) + longkong (12 x7 m) = 238 trees/ha

Field size : 5 000 m²

- C - **amount of fertilization** for both rubber and associated trees. Optimization of trees growth and soil fertility rebuilding.

TRIAL N° 6
To decide whether or not this trial is relevant in our priorities. Probably Second priority.
To be designed : probably selection of 1 combination rubber + associated trees with 3 levels : no fertilization, medium level, high level
3 plots x 2 rep = 6 plots per field with 2 fields (total 4 replications).
Field size : 6 000 m²

- D - type of **intercrops or covercrops during immature period :** anti erosion strategy; Anti Imperata strategy ; sloppy land rehabilitation

This experimentation may be done on other trials as a sur-imposition of existing design.

EXPERIMENTATION ON INTERCROPS DURING THE FIRST 3 years
Rice/cassava/pineapple/banana.....

EXPERIMENTATION DURING THE YEAR 4 to 6
Shading tolerant plants
Ginger.....

- E - **Clonal rubber trial** in RAS 2 environment.

RAS 2/IGPM
TRIAL N° 7

The treatment is on rubber clone :
PLOTS
1 RRIM 600 rubber monoculture = control
2 rubber RRIM 600 + banana cluster + mix of durian/petai/longkong (6 x 7 m = 238 locations = 714 trees/ha)
3 rubber r PB 260 + banana cluster + mix of durian/petai/longkong (6 x 7 m = 238 locations = 714 trees/ha)
4 rubber BPM 24 + banana cluster + mix of durian/petai/longkong (6 x 7 m = 238 locations = 714 trees/ha)
5 rubber RRIC 100 + banana cluster + mix of durian/petai/longkong (6 x 7 m = 238 locations = 714 trees/ha)

Field size : 5 000 m²
The objective is to identify the suitability of selected clones to RAS environment.

SUMMARY OF POTENTIAL ON FARM TRIALS

trials	RAS 2 /T a	RAS 2 /F a	RAS 2 /F +T	RAS 2 /T b	RAS 2 /F b	RAS2 fertilization	RAS 2 /IGPM
Priority	1	1	1	2	2	3	1
field area in m²	5 000	6 000	6 000	6 000	5 000	6 000	5 000
nb of rep	5	5	5	5	5	4	5
trial area in ha	2.5	3	3	3	2.5	1.2	2.5
TOTAL TRIAL AREA	18.2 ha						
TOTAL NB OF FIELDS	34						

This preliminary programme should be later discussed with the local scientists team and the farmers in order to define the relevant methodology adapted to local conditions.

ANNEX 1
SRAP publications and projects documents

PUBLICATIONS

1997

Penot E. *From shifting agriculture to sustainable jungle rubber in Indonesia : a history of innovations integration for smallholders in peneplains of Sumatra and Kalimatan since the turn of the century. (Provisory title)* . Paper to be presented to the ICRAF workshop on "indigenous strategies for intensification of shifting cultivation in Southeast Asia". June 1997. In progress.

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1996

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***For the West-Kalimantan* province:**

Field report October 94/1
Field report November 94/2
Field report december 94/3
Field report February 95/1
Field report May 95/2
Field report July 95/3
Field report October/November 95/4
Field Progress report February/April 96/1
Field Progress report July 96/2
Field Progress report November 96/3
Field Progress report February 97/1

For the Jambi province

Field report September 1994/1
Field report April 1995/1
Field report November 1995/2
Field Progress report March 96/1
Field Progress report July 96/2
Field Progress report November 96/3
Field Progress report February 97/1

For West-Sumatra :

Field report may 95
Field Progress report March 96/1
Field Progress report November 96/2

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ANNEX 3

LATEST UP TO DATE PUBLICATION FROM RRIT ON RUBBER/FRUIT/TIMBER TREES ASSOCIATION IN SOUTHERN THAILAND

AGROFORESTRY UNDER RUBBER PLANTATION IN THAILAND [1/]

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ABTRACT

The experiment was conducted to investigate the appropriate of agroforestry for rubber plantation. The shade-tolerant trees such as rattan, found that *C. caesius*, *C. longisetus*, *C. peregrinus*, *C. godefroyi* and *C. latifolius* can be planted under shade of rubber. They exhibited none effect on growth and yield of 9-year rubber. Neem tree or thiem (*Azadirachta excelsa*), suitable to plant as intercropping for 0-3 years old rubber. Thiem can be planted at the rate of 50% of the rubber density, there was none significantly different on the growth of 6-year rubber intercropped with thiem. Thang (*Litsea grandis*), general found in the mature rubber plantation in southern region, suitable to plant as intercropping for 4 (and more than) -year rubber. *Acacia mangium* is not suitable to plant as intercropping in rubber plantation because it grew very fast and the value of timber is less than others forest tree. The supplementary crops for short-term are *Sallacca* spp, cadamom, torch ginger, red ginger, turmeric, galingale and etc. These crops are shade-tolerant, should be planted with forest tree as intercropping in rubber plantation.

1/ : Paper presented at Joint Thailand / Malaysia Technical Seminar on Rubber, 7-9 April 1997, Kata Beach Resort, Phuket, Thailand

DISCUSSION AND CONCLUSION

1) Thiem can be planted as intercropping in immature rubber (not more than 6-year rubber), at the approximately planting density 50% of the density of rubber in southern region. The planting density of thiem in mature rubber should less than in immature rubber.

2) The result in (1) can be applied to the others shade-tolerant forest tree.

3) For the experiment and extension in smallholders plantation, planting density of the forest tree as intercropping should not more than 20% of the density of rubber.

4) Rattan can be planted as intercropping in the immature and mature rubber, but of some rattan species obstruct and make trouble for working and tapping. The management of these species in rubber is now during investigated.

5) The pattern of planting shade-tolerant tree in rubber plantation should be base on forest tree due to :

- for decreasing the imported wood and timber.
- hight cost for income, easily for planting and tending.
- improving the ecology.

6) Nevertheless, shade-tolerant herbaceous crops should be also intercropped with forest tree for income of the smallholders in short term.

7) The meaning of "Agroforestry under Rubber Plantation" is the intercropping include herbaceous crops, forest trees in rubber plantation. It is not only for supporting sustainable income of smallholders but also improving the ecology better than planting rubber as monoculture.

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ANNEX 4

EXTRACT FROM SIMILAR RESEARCH ON RUBBER + FRUITS TREES IN MALAYSIA FROM RRIM, 1995

MENINGKATKAN PENDAPATAN

Perladangan Campuran Getah dengan Pokok Buah-buahan

Kemungkinan meningkatkan pendapatan pekebun kecil getah yang mengusahakan tanaman campuran getah dengan pokok buah-buahan kini sedang dikaji. Kira-kira 43.7% daripada klon RRIM 901 dalam satu percubaan di FELCRA Tebing Tinggi dengan ukuran lilitan batang melebihi 45 cm telah dibuka untuk torehan dalam bulan Oktober, iaitu 60 bulan selepas ditanam di kebun.

Kadar pembesaran batang pokok-pokok getah yang ditanam dalam tiga barisan pepagar adalah 8.7 cm setahun, menurun 9.5% dalam pembesaran batang berbanding dengan kontrol (monokultur). Hasil yang diperolehi dalam 11 bulan pertama menoreh dengan sistem ½S d/6 ET 2.5% adalah 4,437 kg atau 24.2 g/t/t. Pada awal bulan Oktober, sebanyak 1,141 pokok lagi telah dibuka dengan itu menambahkan bilangan task daripada tiga kepada lima dan bilangan pokok yang ditoreh meningkat kepada 78.3%.

Pokok-pokok tanaman selingan, iaitu cempedak dari klon-klon CH 29 dan CH 30, memberi hasil yang banyak dalam musim buah yang keempat dalam bulan Ogos hingga Oktober. Sejumlah 9,666 buah terdapat pada 330 pokok yang berbuah atau 79.5% daripada seluruh tanaman cempedak. Setelah buah dipilih dan dijarangkan, 7,926 buah gred komersil yang mengatasi 1 kg telah dibungkus. Hasil-hasil yang diperolehi daripada pokok-pokok yang ditanam dalam lorong-lorong selebar 22 m sama ada dalam satu barisan dengan jarak 6 m di antara tiap-tiap pokok (kepadatan 44 pokok/ha), atau dalam dua barisan dengan jarak 9 m (88 pokok/ha) atau dalam tiga barisan 6 m × 6 m (kepadatan 198 pokok/ha) adalah masing-masing 26.1, 16.8 dan 16.2 buah.

INCREASING INCOME

Mixed Cropping of Rubber with Fruit Crops

The possibility of increasing the income of rubber smallholders practising mixed cropping of rubber with fruit trees is being evaluated. About 43.7% of clone RRIM 901 in a trial at FELCRA Tebing Tinggi with girth above 45 cm were opened for tapping in October *i.e.* 60 months after field establishment.

The girthing rate of rubber trees planted in three hedgerows was 8.7 cm per year, a drop of 9.5% in growth as compared to the control (monoculture). The yield obtained during the first 11 months of tapping on ½S d/6 ET 2.5% was 4,437 kg or 24.2 g/t/t. At the beginning of October, a further 1,141 trees were open-tapped thus expanding the number of tasks from three to five and the number of trees in tapping increased to 78.3%.

The intercrop plants, mixtures of cempedak clones CH 29 and CH 30, provided a bumper harvest during its fourth fruiting season in August to October with a total of 9,666 fruits from 330 bearing trees or 79.5% of the cempedak population. After selection and thinning, 7,926 fruits of commercial grade of above 1 kg were wrapped. The yields recorded from the trees planted in the 22 m wide interrows either in single rows of 6 m apart (density 44 trees/ha), or in double rows of 9 m apart (density 88 trees/ha) or in triple rows of 6 m × 6 m (density 198 trees/ha) were 26.1, 16.8 and 16.2 fruits, respectively. The comparative yield performance and percentage fruiting of trees planted in a single row or at higher densities in double or triple rows did not differ

BILANGAN BUAH CEMPEDAK DARIPADA PROJEK GETAH-CEMPEDAK DI FELCRA TEBING TINGGI, SEGAMAT
(musim buah yang ke-4 pada umur enam tahun)
CEMPEDAK FRUIT COUNTS FROM RUBBER-CEMPEDAK PROJECT AT FELCRA TEBING TINGGI, SEGAMAT
(4th round of fruiting at six years of age)

Perjarakan/ *Planting*	Bil. pokok*/ *No. of trees*	Peratus pokok berbuah/ *Percentage of fruiting trees*	Bil. buah/ *No. of fruits*	Bil. buah/pokok/ *No. of fruits/tree*
Satu barisan (66 pokok/ha)/ *Single-row (66 t/ha)*	95	86.3	2,483	26.1
Dua barisan (88 pokok/ha)/ *Double-row (88 t/ha)*	80	82.5	1,347	16.8
Tiga barisan (198 pokok/ha)/ *Triple-row (198 t/ha)*	240	75.8	4,096	17.1

*Selepas dipilih dan dijarangkan/*After selection and thinning*

Prestasi hasil bandingan dan peratus pembuahan pokok-pokok yang ditanam dalam satu barisan atau pada kepadatan-kepadatan yang lebih tinggi dalam dua atau tiga barisan tidak menunjukkan perbezaan yang signifikan. Melihat daripada respon penghasilan cempedak yang baik seperti yang ditunjukkan dalam projek ini, dianggar pendapatan tambahan RM3,000 hingga RM5,000 sehektar setahun (bergantung kepada kepadatan penanaman) dapat diperolehi daripada tanaman campuran seperti ini sehinggalah dalam tahun pertama pengeluaran getah.

Ternakan Kambing Biri-biri di bawah Pokok Getah

Hasil penyelidikan sebelum ini menunjukkan ternakan kambing biri-biri di bawah pokok getah boleh menjimatkan sehingga 25% dalam kos merumpai dan memberi 10% pulangan

significantly. Judging from the good yield response of cempedak reflected in this project, it is estimated that an additional income of RM3,000 to RM5,000 per ha per year (depending on the planting density) could be obtained from this kind of crop combination even during the first year of rubber production.

Sheep Rearing under Rubber

Previous results indicated that sheep rearing under rubber can save up to 25% in weeding cost and provide 10% return to investment. This is based on grazing on naturalised forage available in the conventional rubber planting system where the productivity of natural forages was quite low.

POTENSI PENGELUARAN KAMBING BIRI-BIRI DALAM SISTEM PENANAMAN BIASA DAN DUA BARISAN PEPAGAR GETAH MUDA

SHEEP PRODUCTION POTENTIALS OF CONVENTIONAL AND DOUBLE HEDGEROW PLANTING SYSTEM UNDER YOUNG RUBBER

[illegible]	[illegible]	[illegible]	[illegible]
Purata hasil bahan kering rumput ragut (kg/ha)/ *Average forage DM yield (kg/ha)**	1,100	1,600	1,600
Kadar ternakan (biri-biri/ha)/ *SR (lamb/ha)*	10	23	36 – 37
Purata peningkatan berat badan harian (g/biri-biri/hari)/ *Average daily gain (ADG)(g/lamb/day)*	97	48	51 – 59
Peningkatan berat badan (kg/ha/tahun)/ *Life weight gain (LWG)(kg/ha/year)*	354	403	670 – 801

*Purata bahan kering di bawah getah belum matang yang berumur 2-3 tahun.
Average dry matter (DM) under immature rubber of 2-3 years old.

kepada pelaburan. Penemuan ini berdasarkan biri-biri meragut tumbuhan semulajadi di bawah pokok-pokok getah yang ditanam mengikut sistem penanaman biasa di mana produktiviti tumbuhan semulajadi adalah rendah.

Penyelidikan kini sedang dijalankan untuk meningkatkan sumber-sumber tumbuhan makanan biri-biri di kebun-kebun getah dengan menggantikan campuran-campuran kekacang biasa dengan spesies pastura yang baik. Matlamatnya ialah untuk meningkatkan pulangan ekonomi

The current research is to improve the forage resources in rubber areas by replacing the conventional legume mixtures with improved pasture species. The ultimate objective is to increase the economic return through increased saving in weed control and higher sheep population per unit area of land.

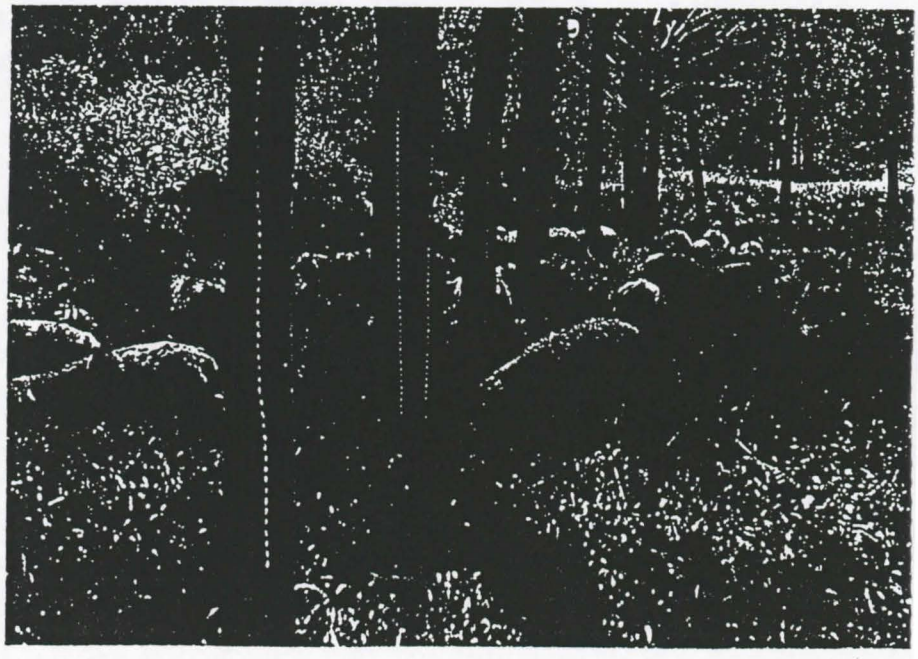
melalui peningkatan dalam penjimatan kos kawalan rumpai dan bilangan ternakan biri-biri yang lebih tinggi bagi seunit kawasan tanah.

Beberapa spesies pastura yang boleh bertahan dan terus produktif di kawasan-kawasan redup dengan ragutan yang sederhana telah dipilih dan dikaji dalam tanaman getah sistem dua barisan pepagar dan sistem biasa. Didapati pastura *Brachiaria humidicola* dan *Paspalum notatum* yang dibubuh baja nitrogen dapat bertahan dengan potensi tumbuh semula yang baik dalam tiga hingga empat minggu.

Hasil-hasil peringkat awal menunjukkan sistem penanaman getah dua barisan pepagar bersama dengan pastura yang baik (*B. humidicola* + *P. notatum*) mempunyai potensi sebagai pastura dan produktiviti ternakan yang lebih tinggi berbanding dengan sistem penanaman biasa dengan pastura yang baik atau tanaman kekacang penutup bumi. Sistem dua barisan pepagar dengan pastura yang baik memberi kadar ternakan yang tinggi, iaitu 36–37 biri-biri/ha dan peningkatan berat badan 670–801 kg/ha/tahun telah diperolehi. Dalam kedua-dua sistem penanaman getah biasa yang dikaji, kadar ternakan adalah 10 biri-biri/ha dan 23 biri-biri/ha, dengan peningkatan berat badan 354 kg/ha/tahun dan 403 kg/ha/tahun masing-masing untuk sistem dengan tanaman penutup bumi, dan dengan pastura yang baik. **Penjimatan dalam kos kawalan rumpai dalam sistem dua barisan pepagar/pastura melebihi 50% kerana sistem-sistem pastura yang berkekalan ini memberi persaingan kepada pertumbuhan rumpai.**

Some strong pasture species that are persistent and productive under moderate shading and grazing were selected and evaluated in the double hedgerow and conventional rubber planting systems. It was found that the nitrogen-fertilised pasture of *Brachiaria humidicola* and *Paspalum notatum* were persistent with a good regrowth potential of three to four weeks.

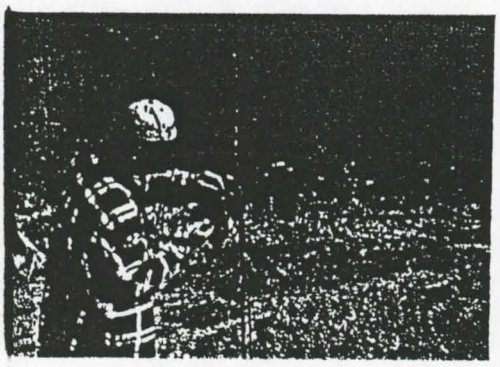
Preliminary results indicated that the double hedgerow rubber planting system along with improved pasture (*B. humidicola* + *P. notatum*) had higher pasture and animal productivity potentials compared to the conventional planting system with improved pasture or legume cover crops. The double hedgerow system with improved pasture provides a high stocking rate (SR) of 36–37 lambs/ha and a good liveweight gain of 670–801 kg/ha/year were obtained. In the two conventional rubber planting systems, sheep SR were 10 lambs/ha and 23 lambs/ha, with a liveweight gain of 354 kg/ha/year and 403 kg/ha/year for the cover crop, and improved pasture systems, respectively. Savings in the cost of weed control in the double hedgerow tree/pasture system exceeded 50% as the permanent pasture system is competitive to weed growth.



HUTAN GETAH

Kerja-kerja penyelidikan dan pembangunan untuk mengenalpasti amalan-amalan agronomi dan sistem-sistem pengurusan yang sesuai untuk membuka kebun-kebun hutan getah diteruskan di Gemas (30 ha), Merchang (30 ha), Kemasul (20 ha) dan Niah (20 ha). Percubaan kepadatan penanaman di Gemas menunjukkan sedikit perbezaan dalam ukuran garis pusat pertumbuhan pokok yang ditanam dengan kepadatan 500 dan 700 pokok/ha tetapi pada kepadatan yang lebih tinggi, iaitu 1,000 pokok/ha, ukuran garis pusat didapati lebih rendah (7.56 cm) pada umur tiga tahun selepas penanaman. Di antara 10 klon yang dinilai, PM 10 memberi ukuran garis pusat yang paling tinggi (6.97 cm) dengan disusuli oleh PB 260 (6.4 cm) dan RRIC 100 (6.36 cm). RRIM 911 mempunyai ukuran garis pusat yang paling rendah (5.56 cm). Pokok-pokok tumbuh dengan lebih subur di Merchang berbanding dengan yang ditanam di Gemas. Klon-klon yang menunjukkan prestasi pertumbuhan yang baik adalah RRIM 937, RRIM 901, RRIM 911 dan PB 235 dengan ukuran lilitan batang yang menjulat daripada 16.1 hingga 19.8 cm pada umur dua tahun selepas penanaman.

Sementara itu pula, penanaman dan penyenggaraan kebun-kebun hutan getah perintis berjalan dengan memuaskan. Setakat ini satu kawasan seluas 800 ha telah dibangunkan di Kemasul, Pahang Darul Makmur, 180 ha di Kerling, Selangor Darul Ehsan dan 1,480 ha di Sandakan, Sabah. Tempat-tempat ini ditanam dengan lebih daripada 22 genotip *Hevea* pada kepadatan 1,000 pokok/ha. Input-input agronomi termasuklah penggunaan baja pelepasan perlahan dan merumpai dengan penggunaan bahan kimia. Walau bagaimanapun, kekacang penutup bumi tidak ditanam dan teres tidak dibuat.



Penilaian penyakit klon *Hevea* yang digunakan dalam projek hutan getah.
Disease assessment of Hevea *clone used in rubber forest-project.*

RUBBER FOREST

Research and development to identify agronomic practices and management systems suitable for the establishment of viable rubber forest-plantations continued at Gemas (30 ha), Merchang (30 ha), Kemasul (20 ha) and Niah (20 ha). The density trial at Gemas showed slight differences in growth diameter of densities of 500 and 700 trees/ha but at a higher density of 1,000 trees/ha, the diameter was smaller (7.56 cm) at three years after planting. Among the 10 clones evaluated, PM 10 had the biggest diameter (6.97 cm) followed by PB 260 (6.4 cm) and RRIC 100 (6.36 cm). RRIM 911 had the lowest diameter (5.56 cm). In Merchang, the trees grew better than those grown in Gemas. The clones that had good growth were RRIM 937, RRIM 901, RRIM 911 and PB 235 with girths ranging from 16.1 to 19.8 cm at two years after planting.

Meanwhile, the establishment and maintenance of pilot rubber forest-plantations progressed satisfactorily. To-date an area of 800 ha was developed at Kemasul, Pahang Darul Makmur, 180 ha at Kerling, Selangor Darul Ehsan and 1480 ha at Sandakan, Sabah. These sites were planted with more than 22 selected *Hevea* genotypes at a density of 1,000 trees/ha. Agronomic inputs including the use of slow release fertiliser and chemical weeding were given. However, no legume planting and terracing were done.

ANNEX 5
PHOTOS FROM EXISTING AGROFORESTRY SYSTEMS IN SOUTHERN THAILAND

PHOTO 1
PLOT 1
RIMM 600 rubber +
neem trees

PHOTO 2
PLOT 2
RIMM 600 rubber +
longkong

PHOTO 3
farmer's PLOT
RIMM 600 rubber (15 years old) +
Mangoustan (2 years old)

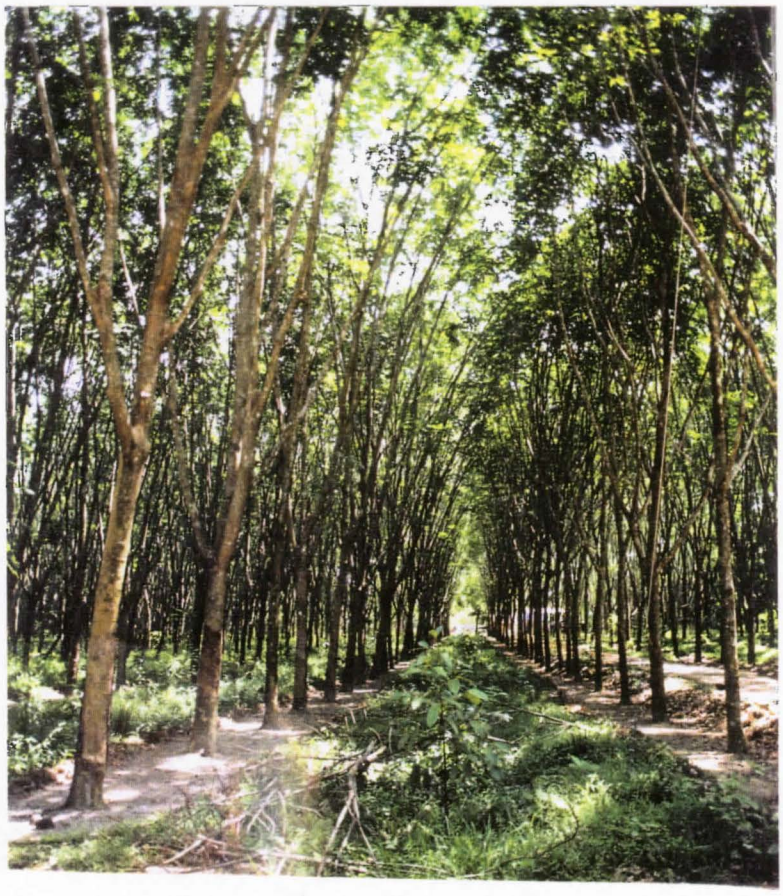


PHOTO 4
farmer's PLOT
RIMM 600 rubber +
"thang" from natural
regeneration

PHOTO 5 PLOT 3
RIMM 600 rubber (5 years old) + longkong + cempedak

PHOTO 6 PLOT 3
RIMM 600 rubber (5 years old) + longkong+ cempedak + banana

PHOTO 7 PLOT 3
RIMM 600 rubber (5 years old) + longkong+ cempedak + banana
Use of space in AF systems.

PHOTO 8 PLOT 4
RIMM 600 rubber (5 years old) large spacing
+ banana cluster with 3 plantsat the same location longkong+ durian + petai

PHOTO 9 PLOT 4
RIMM 600 rubber (5 years old) large spacing
+ banana cluster with 3 plantsat the same location longkong+ durian + petai

PHOTO 10 PLOT 4
RIMM 600 rubber (5 years old) + banana cluster with 3 plantsat the same location longkong+ durian + petai
Detailled picture of how the 3 young plants are protected by banana

PHOTO 11
PLOT 5
3 plantsat the same
location longkong+ durian
+ petai 8 years after planting.

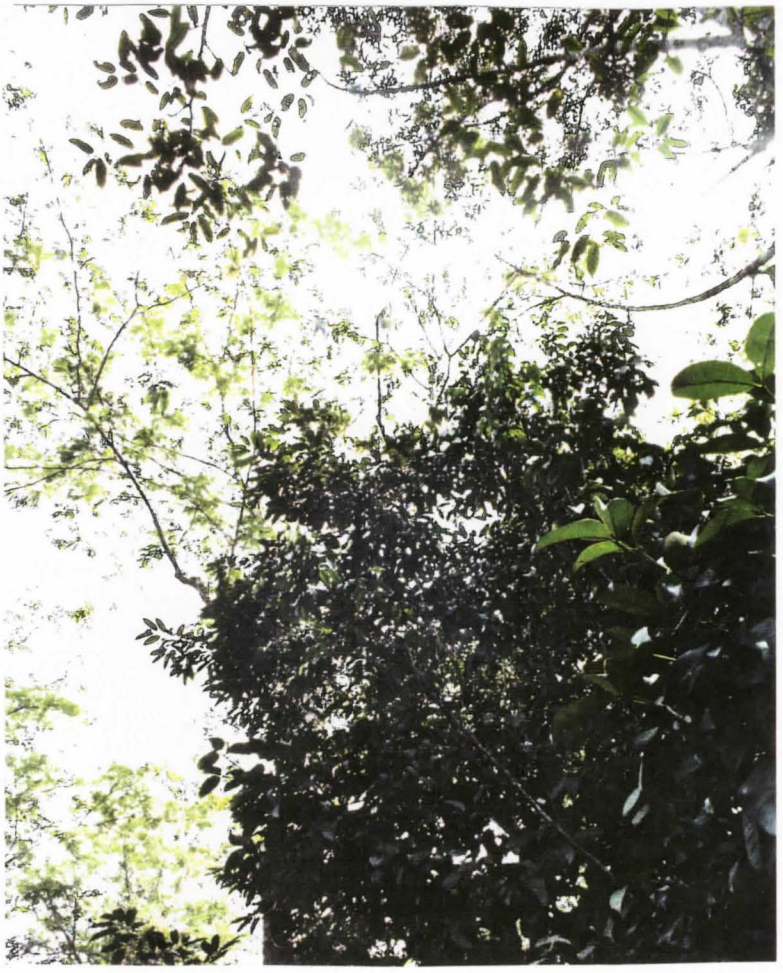


PHOTO 12
Canopy of the system
with 3 plants per location
Rubber

neem tree

petai

durian

langkong

PHOTO 13 farmer'sPLOT
RIMM 600 rubber (1 years old) + intercropping with pineapple

PHOTO 14 farmer'sPLOT
RIMM 600 rubber (1 years old) in monoculture with no intercropping and no covercrops invaded by local weeds.

PHOTO 15 farmer'sPLOT

RIMM 600 rubber (4 years old) in agroforestry system with no intercropping and no covercrops invaded by local weeds : insufficient number of associated trees : no shading : presence of *Imperata c* and *Chromolena O.*