CIRAD-CP
Rubber Programme

REPORT ON THE MISSION TO VIETNAM from 16th October to 1st November 2000

J.M. Eschbach

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CONTENTS

Introduction

Under agricultural diversification project Cr.3099 (ADP) funded by the World Bank, and in compliance with scientific programming for 2000, this CIRAD scientific support mission was undertaken for the following purposes:

- examine the current situation of the adaptive research component and take stock of trials in a controlled environment in the Highlands,

- propose trials in the natural environment, based on agronomic and socio-economic conditions in the central coastal provinces.

The mission was partly undertaken with Eric Penot, from the CIRAD-TERA THI programme, in order to have a combined agronomy/socio-economics approach to identify themes to be tested on smallholdings, and the protocol proposals.

The field visits were carried out accompanied by:

- Mrs TRAN THI THUY HOA, deputy director of IRCV, and all the Division managers.
- Mr Frank ENJALRIC, from CIRAD-CP, the coordinator for adaptive research aspects of the ADP project.
- Mr Stéphane BOULAKIA, from CIRAD-TERA, for farming systems aspects,
- Mr Henk ZWINDERMAN, ADP Smallholder Rubber Development Specialist (SRDS)

Persons met

Mai Van Son	Director of IRCV
Tong Viet Thinh	Director the IRCV Centre in Pleiku
Lan	Deputy Manager of the Krong Buk estate
Tanh	Deputy Manager of the Eah Leo estate
Cu	Deputy Manager of the Kontum estate
Hiep	from the Mang Yang estate
Khanh	Manager of the Chu Se 1 estate
Binh	Deputy Manager of the Chu Prong estate
Hoang	Vice-Chairman of the People's Committee in Thua Thien Hue province
Kiem	PPMU of Thua Thien Hue province
Hung	Deputy Director of Agriculture (TT Hue)
Ngon	Manager of the Lam dong estate
Minh	Deputy Manager of the Quang Tri estate
Dieu	PPMU, Head of the Agriculture technical department (Q. Tri)
To	Head of the PPMU in Quang Binh province
Binh	PPMU, Quang Binh
Manh	Technical Manager of the Viet Trung estate
Huynh Tran Quoc	Head of the Farming Systems Department, ISA

Acknowledgements

We should like to thank the Director of IRCV, along with the heads of the Agriculture Services in the coastal provinces, for their hospitality and the time they gave up. Our thanks also go to Mrs Hoa and Frank Enjalric for the excellent organization of this mission, and to Stéphane Boulakia and all the IRCV team in charge of the project.

Mission schedule

Monday 16/10	Departure from Montpellier
Tuesday 17/10	Arrival in Ho Chi Minh City
Wednesday 18/10	Travel to Buon Ma Thuot Tour of the Krong Buk estate Tour of the Eah Leo estate Travel to Pleiku
Thursday 19/10	Tour of the Kontum estate Tour of the Mang Yang estate
Friday 20/10	Tour of the Chu Se 1 estate Tour of the Chu Prong estate Results of the rubber tapping trials
Saturday 21/10	Results of the rubber fertilization trials Tour of the IRCV concession and trials at Chu Prong.
Sunday 22/10	Presentation by E. Penot at IRCV in Pleiku Travel to Quang Ngai.
Monday 23/10	Travel to Hue, Thua Thien Hue province. Tour of smallholdings, Nam Dong district
Tuesday 24/10	Tour of smallholdings, Nam Dong province
Wednesday 25/10	Travel to Dong Ha, Quang Tri province Tour of the Quang Tri estate
Thursday 26/10	Tour of smallholdings, Cam Lo district Tour of smallholdings, Vinh Linh district Travel to Dong Hoi, Quang Binh province
Friday 27/10	Tour of the Viet Trung estate
Saturday 28/10	Tour of smallholdings, Bo Trach district
Sunday 29/10	Return to Ho Chi Minh City
Monday 30/10	Presentation by E. Penot on smallholder trials at IRCV Scientific programming for 2001.
Tuesday 31/10	Mission debriefing Departure from Ho Chi Minh City
Wednesday 1/11	Arrival in Montpellier

I. Coastal Provinces Project

The structural weakness of PCU should be noted, be it in human resources or logistics. The arrival of the Smallholder Rubber Development Specialist (SRDS) will make it possible to partially remove these restrictions. However, the adaptive research component benefits from strong IRCV involvement: there is substantial and well-monitored research in a controlled environment. As the coastal provinces are confirming their dyanamism and their interest in the project, it is now necessary to provide preferential support to those provinces, and rapidly set up on-farm trials and demonstration plots. An IRCV team, which should be resident on site, will monitor this network.

The budwood gardens are well supervised by IRCV, but the latter needs to be able to provide expertise, quality control and approval for planting material production by nurserymen. In fact, the planting material is usually of mediocre quality; some of the nurseries visited had received neither fertilization nor irrigation.

The reference technical standards are those of the State or provincial estates, which are not always appropriate for smallholdings. If the scheduled trials make it possible to find more suitable crop management sequences, it is important to comply with the technical recommendations of the project defined in the Project Implementation Plan (PIP) dated 12/6/98, chapter 2, pages 1 and 2 (Annex 1). IRCV, in conjunction with SRDS, will update and circulate technical recommendations to the PPMUs for planting material preparation, land preparation, planting and designs, upkeep and fertilization, and tapping, with training for supervisors and publication of technical datasheets.

Likewise, the land areas visited for future extensions do not always correspond to the criteria defined in the PIP, chapter 2 Appendix 2, page 7, figuring in Annex 2. In Cam Lo district, hydromorphic soils and cleared Eucalyptus areas should be avoided.

Whilst follow-up of these recommendations is a prerequisite for the success of smallholder plantations, it is not sufficient alone.

Soil and climatic conditions in the 3 coastal provinces visited are suitable for rubber development on the whole. Among the numerous types of soils, the prevalent ferrallitic soils (red soils) that have formed over schists and sandstones are suitable for rubber if they are deeper than 1 m, and if the texture is sufficiently mellow for rubber to develop its taproot system. The only climatic restrictions are:

1) There can be a notable water deficit during the dry season, especially in Quang Tri province.

2) Typhoons, which are particularly dangerous in a zone of 20 to 30 kilometres inland. The rubber plantings set up in 1960 are still producing and the 20% of trees that have suffered from broken branches have re-formed their canopy. Deep soil is essential to prevent uprooting, and it is indispensable to choose clones that are resistant to wind damage.

The agricultural performance of the existing plantings does not reflect the potential of these zones; the poor performance is due to a lack of skilled technicians and extension officers, and to a shortage of funds. Growth in the smallholdings visited varies from 2 cm/year (Bo Trach district) to 8cm/year (PB 235 at Nam Dong) depending on the sites and cultural practices. In the clone trial in Quang Tri province (CTQT88), PB 235 production is around 1,600 kg/ha/year at 3 years: there is therefore true potential.

Quang Binh province, where 6,300 ha have already been planted, is planning to plant around 570 ha in 4 districts at the end of 2000: 300 ha at Tuyen Hoa, 140 ha at Minh Hoa, 80 ha at Bo Trach and 50 ha at Le Thuy. It is in Bo Trach district that the extensions eventually due to be set up are the largest (2,710 ha). The land is currently being prepared. The clones planted are those recommended by the project: RRIM 600, GT 1, PB 235, VM 515 and PB 255.

In Quang Tri province, rubber occupies 10,451 ha, around 5,600 of which are family farms, mostly in the districts of Vinh Linh (3.888 ha), Gio Linh (1.044 ha) and Cam Lo (662 ha). For 2000, there are plans to plant 500 ha (Gio Linh, Cam Lo and Vinh Linh) and rehabilitate 1,900 ha.

In Thua Thien Hue province, around 2000 ha have already been planted, mainly in the form of family farms in the districts of Nam Dong (700 ha), Phong Dien (400 ha) and Huong Tra (300ha). Around 100 ha are scheduled for the end of 2000, in Nam Dong district. Rehabilitation will involve 1,500 ha.

The ADP project appears to be seen as a relay with project 327, though the credit conditions are different. Since project 327 (launched in 1992) was halted in 1998, the relay was partly ensured by provincial budgets, pending the ADP project. In Quang Tri province, which is very dynamic, credit is currently free. Smallholders do not always know the total of their credit.

The current price fetched by wet (50%) cup lumps is 3,500 dongs. In the South, the rubber produced by private operators is easily marketed through middlemen. The dry rubber price is 8,800 dongs/kg, or 0.62 US dollars.

II. Adaptive research

The IRCV centre at Pleiku has 9 researchers; the managers and division heads are as follows:

- Pham Hai Duong — Rubber breeding (Mr. Thuy)
- Tran Minh — Rubber tapping (Mr. Thanh)
- Tran Nam Viet — Fertilization and cover crops (Mrs Van)
- Vi Van Toan — Plant pathology (Mr. Dung)
- Le Gia Trung Phuc — Farming systems
- Vi Van Toan — Manager of Chu Prong station

The laboratories at IRCV's Pleiku centre are still being equipped: rubber quality control, sample preparation room for soil and leaf analyses. More specific items of equipment for measuring the physical properties of soil, penetrometers, tensiometers, will be purchased under the INCO-SARI project. Remember that it is necessary to arrange for a Latex Diagnosis laboratory, in addition to the portable lab. Apart from investment in premises, agricultural implements and measuring instruments, it would also be useful to allow for the installation of a small automatic weather station. For the other trial points, see the national weather station network before purchasing any equipment.

The library would benefit from having a few basic books, and subscriptions to rubber cultivation documents, such as:

- Rubber, 1989, Webster and Baulkill.
- Le caoutchouc naturel, 1986, Maisonneuve et Larose.
- Rao, 1975, Maladies of Hevea in Malaysia, RRIM, KL.
- Shorrocks, 1964, Mineral deficiencies in Hevea and associated cover plants, RRIM, KL.
- Physiology of rubber tree latex, 1989, CRC Press.
- Plantation, recherche, développement, two-monthly, CIRAD.

IRCV will draw up two half-yearly scientific reports per year, for the PCU, which will pass them on to the other organizations. These reports, in English and Vietnamese, will present the annual results of ongoing trials: records for the season, cumulated data, statistical analysis, results, rundown of recommendations.

The Research Centre for Smallholder Rubber Development, was set up by IRCV in 1996. In particular, this Centre has a Training Division and an Extension and Research Division. The

Extension Division employs several people assisted by the provincial extension services at Pleiku for Quang Ngai, Gia Lai, Kontum and Dak Lak, at Quang Tri (An Loc branch) for the coastal provinces in the Centre-North. Demonstration plots have been set up in 11 provinces: clonal diversification and polybag planting, fertilization, upkeep, disease control and tapping. A branch of the IRCV Extension Centre has been operating from the offices of the GERUCO company in Quang Tri since June 1997.
The activities of this Centre need to be strengthened and programmed in accordance with the Research Component of the Project, which is also entrusted to IRCV. The team in place would benefit, eventually, from being enlarged and could become integrated with the Project team, which, remember, must absolutely reside in the coastal provinces, in order to supervise the setting up of on-farm trials.

The adaptive research programme focuses on three aspects: the socio-economic study, farming systems and rubber cultivation.

1. Identification of agro-socio-economic factors linked to rubber integration.

1.1. Project information, training, expertise and partnership.

Contacts have been maintained with the provincial authorities and the PPMUs to analyse the conditions for project implementation and clarify the adaptive research. Establishing partnerships with bodies offering skills in socio-economic matters has been launched with ISA.
A researcher from IRCV, Le Van Ngoc, has received training in the English language and in participatory research with the NGO Helvetas. He will be particularly following up this socio-economic component and will be trained in the second half of the year to analyse survey and farming system data at CIRAD-TERA with E. Penot. The possibility of providing funding for trainees will be examined with the French Embassy in Hanoi, and with the Consulate General in Ho Chi Minh City.
International technical assistance will be provided by an expert specializing in the socio-economics of rubber, in the second half of 2001, to assist in organzing the formal survey for typology verification. CIRAD is ready to provide technical assistance in this matter.

Relations with the other research structures are continuing, particularly with WASI for coffee, ISA for rice, and SOFRI for fruit trees.

1.2. Rural diagnosis, farm typology and network of reference farms

The aim is to establish:
- zoning of the region based on agro-socio-economic factors,
- a farm typology to determine technical objectives,
- a network of representative reference farms to measure research impact.

This component is due to be launched at the beginning of 2001, after examination of the replies to the call for bids which is to be issued. The terms of reference were sent to the PCU at the beginning of July and are currently being reviewed with SRDS; in particular, the list of provinces involved, Kontum, Quang Binh, Quang Tri. The expected timetable is as follows:

- 2/01, team training
- 2-3/01, data gathering in 5 municipalities
- 4-5/01, informal diagnosis of the municipalities, establishment of a typology
- 5-7/01, formal surveys of 50 to 60 families per municipality in 5 to 10 villages
  choice of reference farms
-7-9/01, synthesis and report.

A database will be developed by SRDS to monitor smallholder plots: this database will be linked to the one for the reference farms. The software used could be Winstat. This aspect covers all activities relative to the Farming Systems study of the PIP, chapter 2, page 19 (Annex 3)

2. Trials on sustainable soil management, farming systems and fodder crops.

2.1. Trials in a controlled environment

A recapitulative table for the trials is given in annex 4.

TDCP99A and B, TDPK99 : collection of food crops and cover crops to find species suitable for the climatic conditions, with a long dry season, and which meet the objectives of sustainable soil management, through direct sowing. Some cover crops may also be used as fodder crops. This collection will be completed with perennial crops. The red soils in the zone, which are highly deficient in potash, along with the long dry season rule out recommending conventional legume cover crops, *Pueraria, Calopogonium, Centrosema, Mucuna,* apart from *Stylosanthes guyanensis,* which is very hardy.

HCCP00: an experimental design covering 4 ha has been set up on a toposequence in the form of a matrix and combines several factors:

- Crop sequence of traditional or introduced food crops, cover crops and fodder crops,
- Increasing fertilizer levels, and slashing + burning: the effect is spectacular
- Soil tilling and direct sowing.

The first food crop harvests have made it possible to position the cycles and identify a few limiting factors: witchweed in grasses, termites and lice on rice, etc.

TXCP00: an intercropping trial has been set up in different rubber planting designs, with treatments depending on capital and labour resources. The livestock rearing component intends to grow *Brachiaria* pasture in the interrow. Banana should be tested.
HKCP00: permanent intercropping systems in a 3 x 3 x 13 double rubber row design are being studied with annual crops (riz), pluriannual crops (pineapple, sugar cane) or perennial crops (coffee, fruit trees, cinnamon, timber trees).
By measuring work time in the intercropping trials, it will be possible to assess the economic merits of such combinations..

TDCP00 and TDCS00: Two trials are comparing cover crops such as *Chamaecrista, Stylosanthes, Axonopus, Paspalum, Brachiaria* under direct light (1999 plantings at Chu Se) and under semi-shade (1996 planting at Chu Prong). It has been confirmed that the last species is well adapted, remains green during the dry season and is well grazed.
TFCS01: *Brachiaria* and other cover crops with *Pueraria*
TFCS97: Trial not visited

2.2. Setting up of demonstration plots on smallholdings – Adaptive research in different agronomic and socio-economic situations

At Chu Se, in the plot belonging to the NGO "ENDA", planted in double rows on 41 ha (41 families), an interrow is showing signs of compaction due to grazing. During the next visit to ENDA there are plans to establish *Brachiaria* (green manure), non-irrigated coffee and fruit trees to make use of this broad unused interrow, in which the soil is deteriorating.

The visits and meetings in the coastal provinces provided an opportunity to propose a few rubber intercropping protocols (Annex 5). The provincial heads involved will collect requests from farmers and researchers from IRCV will carry out a mission in mid-November to finalize the choice of treatments, the protocols and work timetables with the farmers on site.

2.3. Training, demonstration and expertise

IRCV organized a national seminar at Pleiku on sustainable soil management at the end of September 2000. It was a great success and vindicated the research themes in this field.
Expertise will also be brought in from outside, through a mission by an expert in this field. The date remains to be determined.

3. Rubber cultivation techniques and experimental work

3.1. Trials in a controlled environment

a) Clones

Budwood gardens for trials and selected material dissemination have been set up on 0.4 ha at Pleiku and on 1 ha at Chu Se 2.

14 small-scale clone trials and monoclonal blocks are being monitored at 11 sites. The results will be used to update clonal recommendations for the 1999-2001 period.

At Krong Buk, in an industrial plot, clone VM 515, with more than 80% tapping panel dryness (TPD) in 1996, received a double fertilizer application rate: TPD incidence, which has fallen to 8%, is especially due to alternation on panel B for the last 2 years. It nevertheless remains highly susceptible to this disease.

CTKB89. The Vietnamese clone RRIV 1 (LH 82/122) performs very well. PB 235 is confirming that it is inappropriate for the altitude conditions. The trial as a whole has been severely attacked by Black Stripe (especially clone PB 310) and Ridomil must be used with a wetting agent. The trees tapped in d/3 without stimulation are not expressing their potential. Two stimulations per year are recommended on all these clones.
As in Indonesia, RRIC 100, which performs well, is showing budding problems.

A mission by a rubber genetics expert is planned for clonal aspects in December 2001, to take stock of recent clonal recommendations and help to formulate recommendations for the 2000–2005 period. CIRAD is ready to provide scientific assistance on this topic.

b) Soil preparation method

Tilling of the entire area to be planted, in order to grow crops in the interrow, is not always appropriate in regions with heavy rainfall and on sloping land. Indeed, soil compaction is seen, as is very intense erosion removing the topsoil which is rich in organic matter. A trial is to be set up at IRCV in Chu Prong in 2001 to compare different ways of preparing soil and controlling erosion.

c) Fertilization

KTFBEL98: a trial set up in June 1998 to study the effect of fertilization and stimulation on adult trees showed no significant fertilizer effect on production. The fertilization/stimulation interaction was not significant either. The trial has been halted as production checks were no longer possible.

The effect of fertilizer applications on adult trees is being studied in trials FBKT92 and FBMY90, converted into a split-plot. For trees with severe deficiencies at Mang Yang, an after-effect was seen on production per tree (g/tree/tapping), and even more so on kg/ha, on trees of the same circumference for the fertilizer applied when the trees were immature. Optimum advantage should be taken of this result, which is substantial and original, through physiological studies and a publication. On the other hand, no effect was seen for fertilizer applied on adult trees, even on the

severely deficient control, which confirms the limited worth of fertilizer applications on adult trees. FBMY97 A and B. Application of organic matter has a positive effect at Mang Yang.

FBCP99: Fertilizer trial CP99 with PB 260, planted on 8 ha in August 99 in polybags (replicates I and II) and stumps (replicates III and IV), involves different application rates and application methods for N, P and K, with preferential use of fertilizers during the growth period. Check the attribution of bag/stump replicates.

Lastly, root system observations should be carried out on the trial at Chu Prong, to fine-tune the fertilizer application method.

d) Cover crops and sustainable management of soils under immature rubber trees

KYCP00: A trial seeking to reduce the immature period of rubber trees has been set up on 6 ha of PB 255 to compare continuous line hoeing, herbicide weeding in the row or planting circle, disking, interrow scything, and mulch. It was installed under poor conditions (late planting from the end of July to the end of August, seed availability) and will no doubt need replanting in 2001.

A particular upkeep method observed at Kontum in the 1996 plantings consists in slashing along the planting row, disking the interrow, then transferring the soil and vegetation from the interrow to the planting row. This procedure is not propitious to good rubber tree root system development in the interrow. Whilst this system eradicates *Pennisetum*, it encourages the installation of *Imperata* and *Boreria*, which are much more difficult to eliminate.

e) Tapping

The shortage of tappers is not acute yet, except in Dak Lak province, and a reduced tapping frequency is being studied to increase work output. At the GERUCO estates, the task volume has been increased from 350 to 450 trees.

3 trials currently under way confirm the merits of stimulated reduced frequency tapping.

KTCS93, d/2 and d/3 with stimulation on GT 1, and TPD monitoring. The rainguards should improve the response to stimulation in rainy periods.

KTMY97:d/3 with stimulation on GT 1.

KTCP98: d/3 with stimulation on RRIM 600.
The stimulation timetable must be followed to the letter, even if there are leaf diseases, even if it means carrying out stimulation every three weeks to comply with the protocol. Once tapping resumes in April or May, reactivating the metabolism by stimulation is justified with stimulation right from the second or third tapping after the panel is reopened.

Three other trials will be set up:

KTMY01 at Mang Yang, to assess the effect of 3/y stimulation on 6 different clones (15 trees/clone, with one control per tree, 2 tappings before and 6 tappings after stimulation, 1-year trial). All the trees will be tapped by the same tapper.

KTCS01 at Chu Se on GT 1 for opening in d/3 0/y and 4/y, d/4 6/y, d/5 8/y and d/6 10/y. Tree growth and production potential will have to be representative (opening at 7 or 8 years and not at 10 years). TPD will have to be carefully monitored.

KTQT01 at Quang Tri, for periodic tapping in d/2 (100 to 120 tappings/year), with a halt in the dry season (3½ months from September to November), with intensive stimulation (4 to 6/y) during the favourable periods.

It would be worth organizing a tapping trial on PB 235 at an altitude under 600m (d/2, d/3 and d/3 2/y), as well as a trial on PB 255, which are clones recommended in the project.

3.2 On-farm trials and demonstration plots

As already mentioned in the 1999 report, it is necessary to set up a few plots right from the first plantings, to begin building up the network of clonal tests and trials testing polybag planting, fertilization and rehabilitation on smallholdings (Proposed protocols in annex 5).

For the clonal trials, the clones chosen will be risk-free for farmers and in accordance with current clonal recommendations. The plants will be provided cost-free by the project, and in return the smallholders will be required to apply the experimental protocol (an example is given in annex 6) and agree not to sell their plots. A contract, to be proposed for discussion with SRDS, will be signed between the smallholder, IRCV and the PPMU. An example is given in annex 5. The same applies for all these types of trials (land preparation, planting design, fertilizers, interrow management, rehabilitation, etc.). IRCV will provide the PPMUs involved with the protocols and a with a draft contract before selecting candidate farmers.

The planting tests will compare several types of planting material preparation, polybags, stumps, etc.

The fertilization tests (annex 7) will not require a control without fertilizer and will be adapted to soil type.

The rehabilitation techniques will seek to define criteria beyond which rehabilitation is economically worthwhile. These criteria will depend, by order of priority, on plot age (4 to 5 years at the most), the number of trees/ha and the circumference. It has been agreed that the plots to be rehabilitated will have a tree density and growth at least equal to 50 or 60% of potential, i.e.:

- a density of 300 trees/ha or more
- growth of 3 to 4 cm per year.

An inventory of the areas and growth results will need to be carried out for all the plots already planted and to be rehabilitated. Credit for that purposes has already been released by the Quang Binh PPMU.

As in the trials, the demonstration plots set up must always include a control, which will remove the need for counter-demonstrations. A rubber plot of polybag plants with one whorl, planted in the village of Cam Tuyen, Cam Lo district, does not look as good as a plot planted with stumps right next door at the same time on another farm.
The trials are to be set up with a maximum of 4 or 5 treatments per smallholder plot, the latter forming a replicate. Identical trials, if possible in the same environment, will be the other replicates on other farms.

Conclusions

Although the project has got off to a difficult and very slow start under poor technical conditions, the adaptive research component is proceeding well at the Chu Prong experimental station, in a controlled environment.

On-farm trials now need to be launched where the dynamics are strongest, i.e. in the coastal provinces. The mission undertaken made it possible to lay the foundations of an initial series of trials: the research personnel potential in this zone therefore needs to be reinforced, eventually with the setting up of a team on site.

The technical standards used are those applied on national or provincial estates and are not always

adapted to smallholdings. IRCV, with the Smallholder Rubber Development Specialist, will need to rapidly draft the technical recommendations of the project in technical datasheet form and circulate them to the PPMUs.

Lastly, with the corresponding funds being made available, it is urgent for IRCV to undertake a vast programme of planting material certification and nursery accreditation, and to launch a training programme for future project supervisors, in compliance with the technical recommendations.

ANNEXES

Smallholder Rubber Development Component
Technical Guidelines

A. AGRICULTURAL PRACTICES

Planting Material Preparation

1. Choice of Clones. Only three clones, which are known to perform well in the central highland, GT1, RRIM 600 and PB 235, would be planted during the first four project years. The proportion would vary between provinces and sites, depending on local conditions (particularly with regard to altitude and wind): for instance, PB 235 would be selected at lower altitudes, while RRIM 600 should not be used in the coastal areas due to potential wind damage. Other clones, such as PB 260, VM 515 and RRIC 100, would be introduced in small proportion after the fifth year, based on results from clonal field trials and recommendations from RRIV and GRC.

2. Nurseries. Planting material would be prepared in polybags in central nurseries. One ha of polybag nursery would produce planting material for 100 ha of plantation. Depending on seed availability, one or preferably two germinated seeds would be sown in each polybag with one removed after two months (second leaf whorl stage). Green budding would start when the seedlings are around three months of age. Polybag plants would be planted at about ten months with one or two developed leaf whorls. In cases where the project communes are far from the central nurseries, bare root budded stumps would be prepared as these are easier to transport over long distances than polybags. The stumps would then be placed in larger polybags in the participating communes and planted in the field after developing one or two leaf whorls.

3. Budwood. All existing budwood gardens in the SRCs and PRCs, would need to be checked and certified by the RRIV to ensure clonal conformity, prior to their use in supplying budwood for budding in the nurseries. Clonal conformity would be established based on the observation of morphological criteria and electrophoresis of selected isozymes.

4. Schedule. To plant a field in year Y0, seeds should be sown in the nurseries in year Y-1 and preparation of budwood for budding the nurseries should start in year Y-2.

Land Preparation

5. Mechanical felling would not be necessary as small rubber holdings would only be established in deforested areas. Felling of isolated trees and clearing of bush would be carried out manually around December and vegetation cut back about two weeks before burning during the dry season between January and March. Weeds should be removed before planting to enhance the growth of the root systems of the rubber trees. A herbicide (glyphosate) should be applied to areas covered with *Imperata*. In some locations, depending on soil conditions and availability of equipment, the loosening of planting rows would be carried out mechanically to a depth of about one meter. Wherever intercropping is not planned, cover crops, consisting in a mixture of creeping legumes (Pueraria, Centrosema and Calopogonium, about 6kg of seeds/ha), should be planted as soon as possible after the land is cleared, to protect the soil from erosion, control weeds, and improve soil fertility.

Field Planting

6. Small holdings, up to about 2 ha, would be planted with monoclonal material. Planting would take place during the rainy season between June and September. The planting layout would be 7m x 2.5m (571 trees/ha) to provide space for intercropping and achieve 450 trees at opening. Triangular arrangements (4m x 4.35m, or 575 trees/ha), which allow faster canopy coverage and reduced maintenance, could also be considered if intercropping is not planned. On slopes between 3% to 8%, rows

would be at a right angle to the slope. Above 8%, trees would be planted along contour lines to avoid erosion. Rows would be oriented east-west to allow better lighting for intercropping. To compensate for the normal mortality rate at planting, about 10% additional plants for polybag plants and 20% for stumps would need to be prepared and supplied for replacement within the first year after planting.

Maintenance

7. Fertilization. Fertilizer recommendations are based on the results of the ongoing fertilizer trials conducted by RRIV in the highland. Each planting hole would receive about 5 kg of organic manure, 1 kg of rock phosphate and 300 g of dolomite, while 300 kg/ha of rock phosphate would be applied to the cover crop. After planting, urea, rock phosphate, potassium chloride, and dolomite, would be applied twice a year, at the beginning and the end of the rainy season, in a circle around the trees during the first two years, along the rows during the following two years and between the rows thereafter. For soils of average fertility, annual fertilizer applications would progressively increase to reach 650 kg/ha in year 4. Total fertilizer applications, from the time of planting to maturity, seven years after planting, would amount to about 5 tons per ha (see Table 1). Fertilizer applications would be reduced to about 200 kg/ha from years 8 to 15, and could be stopped after year 15. Fertilizer doses would be increased during the immaturity period if the soils are particularly poor, according to the recommendations of RRIV and GRC.

8. Weeding. Upkeep is critical during the first two years to avoid competition for water and soil nutrients between rubber trees and weeds and ensure satisfactory growth of the trees.
Weeding would be done manually, but herbicides could be used after the first year when the tree stems have lignified. The trees would be mulched with plant residues in a circle to limit evaporation during the dry season.

9. Tree Care. Disbudding rounds would be carried out every two months, and then monthly during the first year. Pruning, to remove offshoots from the trunk to obtain a tapping panel of at least 2.5 m in height, would be carried out every two months during the second and third years. If necessary, branch induction would be carried out at 2.5 meters. Bamboo fences would be installed to protect holdings from cattle. Fungicides would be used particularly on adult trees to treat Corticium or black stripe disease to which clone RRIM 600 is particularly sensitive.

Production

10. Tapping Systems. Tapping would start when about 100 trees/ha reach a girth of 50 cm above the ground. The tapping cut would be opened at 1.20 m above the ground. Additional trees would be opened within the following two years with the aim of reaching about 450 tappable trees per ha. It is estimated that, on average, trees would reach tappable girth and tapping would start in the eighth year after planting. Tapping would continue for about 20 to 25 years. Starting in the third year of tapping, the panel would be changed every year after wintering. Tapping would stop for two to three weeks during wintering and during the rainy season. There would be about 260 to 270 tapping days per year. While tapping systems would be based on the results of current field trials, it is now envisaged that trees would be tapped in half spiral, every third day or fourth day, six days a week, and would be stimulated with Ethrel at 2.5%. Depending on tapping frequency (d/4 or d/3), trees would be tapped 60 to 90 times a year. With maximum 20 cm bark consumption per year, trees would be tapped on virgin bark for 12 years. A farmer would tap a maximum of 500 trees per day, corresponding to a planted area of 1.25 ha.

Smallholder Rubber Development Component

Appendix 2

Criteria for Selection of Project Sites for Smallholder Rubber Plantations

Basis for Selection

1. Decision No. 86TTg, dated February 05, 1996, of the Prime Minister approving the Master Plan of Vietnam Rubber Development from 1996 to 2005, included climatic criteria and soil appropriate for ecological areas of rubber.

2. Proposed criteria mentioned in the Feasibility Study Report of the Agricultural Diversification Project – Smallholder Rubber Development prepared by MARD and SOFRECO consulting firm (France) (May 1997).

3. Selected Districts in the Project Provinces were based on proposals of the Provincial Peoples' Committees and with the agreement of MARD.

Criteria

4. Natural Conditions:
   - Annual rainfall is greater than 1,200 mm per year.
   - The dry season should not last more than 4-5 months. In case of Basaltic Red soils, which have a deep top soil and high water retention capacity, rubber trees can withstand up to 6-7 months of dry season.
   - The average wind speed is less than 6m/s.
   - Altitude is less than 800m above sea level.
   - The soils should have
     - ◊ More than 0.8m thickness of top soil
     - ◊ Good drainage capability
     - ◊ Soil texture of less than 85% sand, and percentage of concrete/rock fragment is less than 35%
   - Slope less than 20%.

3. Socio-economic Criteria:
   - Priority should be given to remote areas where, for the most part, farmers are ethnic minorities or poor Kinh.
   - Priority should be given to areas where other crops were previously grown but obtaining low economic efficiency, barren land, or recently fallowed cultivated land.
   - No allocation of rubber should be undertaken on land with perennial crops or forest land.
   - Land allocated should be outside the concessions of Rubber Companies.

3. Environmental Criteria:
   Selected areas for rubber plantations should be outside of :
   - Forest land (planted forest, regenerated forests, or maintained forests);
   - Natural preservation areas; and
   - National Parks.

Smallholder Rubber Development Component

Terms of Reference - Farming Systems Study

Background: Smallholder farmers in project provinces operate traditional crop or crop/livestock farming systems. The project will introduce rubber as a crop which will lead to the diversification of these systems. While the existing farming systems have been in place for a long time in Highland provinces covered by the project, insufficient analysis has been done to find ways of maximizing production and find alternative crop or crop/livestock mixes. The introduction of rubber with its long immaturity phase necessitates the exploration of alternative systems which could provide increased income while waiting for rubber to come into production. The project will commission a study to be carried out by local universities/institutes to analyze ongoing farming systems and, on the basis of findings, make recommendations for modified or alternative systems which can lead to increased income generation.

Activities: Farming systems analysis (technical, social, economic); testing of modifications and alternatives; liaising with agricultural - crop, livestock and treecrop research; and formulating recommendations for maximization of production and income from improved or alternative systems.

Tasks:

1. Research study design

2. Identification and classification of prevailing farming systems in three highland provinces included in the project

3. Undertaking field work

4. Completing analysis

5. Identifying modified or alternative farming systems models

6. Running simulation tests of modified or alternative models

7. Analyzing results of testing and making recommendations

8. Presenting findings to MARD

Duration and Timing of Assignment: The study would take place between Project Year two and Project Year five. A sum of about US$25,000 would be available each year to cover costs.

Annex 4

Recapitulative table of trials in a controlled environment

		IRCV	GERUCO									Others		Total
Estate		Chu Prong	Chu Prong	Chu Se 1	Chu Se 2	Duc Co	Eah Leo	Kon tum	Krong Buk	Mang Yang	Plei Can	Hue	Quang Tri	
Large scale clone trial	CT	00	98	93		86	97	85	89	88,92		97	88	11
Fertilization	FB	99						92		90,97 A,B				5
Farming systems	HC	00												1
Intercrops	HK	00												1
Tapping	KT		98	93,01						97, 01			01	6
Reduction of immature period	KY	00												1
Monoclonal blocks	QT		85											1
Breeding	SG	00		97										2
Small scale clone trial	ST	99									87			2
Food crop collections	TD	99A												1
Cover crop testing	TD	99B	00	00										3
Cover crop	TF			01	97									2
Intercrops	TX	00												1
Monoclonal plot	XT					94								1
Total		10	4	6	1	2	1	2	1	7	1	1	2	38

Code : CTCP00

CT : Large scale clonal trial
CP : Chu Prong
00 : set up in 2000

PROPOSED PROTOCOLS FOR THE ON-FARM TRIALS

Protocols common to the 3 provinces

Clone trials

T1 GT1
T2 RRIM 600
T3 PB 255
T4 PB 260, RRIC 100, RRIM 712, VM 515, PB 235 or RRIV 2,4.

Planting trials

T1 Stump, 10 months old
T2 Stump, in polybag no whorl
T3 Stump, in polybag one whorl

Fertilization trial

T1 Half-rate
T2 Standard rate
T3 Double rate, with possible halt at 4 years

Rehabilitation

T1 Control
T2 Double fertilizer rate
T3 Double mineral and organic fertilizer rate

Thua Tinh Hue

Fertilizer trial on intercropped tea at Lam Dong

Trial testing fertilization on opening (RRIM 600 1993)

Trial testing circumference on opening

T1 Control opened at 50 cm
T2 Opening at 45 cm

Fruit trees on 3 x 1,500 m2 (0.45 ha)

T1 Normal control design (7 x 2.5 m): upland rice, smallholder practices.
T2 Normal design with a mixture of pineapple, Cayenne variety, banana (during the immature period), longan and rambutan (275 fruit trees, 6 x 6 m), the last two withstanding partial shade, *arachis pintoi* or *cassia rotundifolia* cover crop.
T3 Double row (13 x 3 x 2.5 m): citrus type, orange, grapefruit (6 x 4 m) mixed with grafted durian (30/ha), with upland rice the first year and *arachis pintoi* or *cassia rotundifolia* cover crop thereafter.

Imperata control on 4 x 1,000 m2 (0.4 ha)

T1 Smallholder practices.
T2 Mixture of fast growing trees: *Acacia mangium* and *Acacia auriculoformis* (3x3m).
T3 Mixture of multiple purpose trees: *Caliandra* (fodder), *Gmelina*, *Acacia mangium* (firewood)
T4 *Brachiaria brizhanta* or *ruziziensis*, alone or mixed with *Stylosanthes guyanensis*.

Annual intercrops on 5 x1,000 m2 (0.5 ha), set up in May 2001.

T1 Smallholder practices.
T2 Cassava at 30 t/ha with appropriate fertilization.
T3 Upland rice at 1.5 t/ha.
T4 Rotation of upland rice at 1.5 t/ha and vegetables (*Vigna radiata*) or legume catch crops.
T5 Rotation of upland rice at 1.5 t/ha and sorghum or grass catch crops.

Quang Tri

Annual intercrops on 5 x 1,000 m2 (0.5 ha), set up in May 2001.

T1 Smallholder practices, rice or groundnut monoculture
T2 Smallholder practices, groundnut or rice monoculture.
T3 Biennial rotation of upland rice at 1.5 t/ha (A1) and groundnut 2 t/ha (A2).
T4 Biennial rotation of millet, from the end of April to July, then upland rice (A1), groundnut, upland rice (A2).
T5 Rotation between taro (A1) and sweet potato (A2).

Design

T1 6 x 2.9 m biennial rotation of upland rice at 1.5 t/ha (A1) and groundnut at 2 t/ha (A2).
T2 7 x 2.5 m biennial rotation or upland rice at 1.5 t/ha (A1) and groundnut at 2 t/ha (A2).
T3 8 x 2.2 m biennial rotation of upland rice at 1.5 t/ha (A1) and groundnut at 2 t/ha (A2).

Quang Binh

Annual intercrops on 5 x 1,000 m2 (0.5 ha).

T1 Smallholder practices, rice or groundnut monoculture
T2 Smallholder practices, groundnut or rice monoculture
T3 Biennial rotation of upland rice at 1.5 t/ha (A1) and groundnut at 2 t/ha (A2).
T4 Biennial rotation of millet, from the end of April to July, then upland rice (A1), groundnut, upland rice (A2).
T5 Sugarcane at 1.5 m and pineapple.

DRAFT CONTRACT FOR AN ON-FARM TRIAL

Party A concerns the project name. It includes the address, names and signatures of the:

- Managing Director of the Project,
- National Coordinator,
- Financial Controller.

Party B concerns the farmer. It includes: the address, status, age, identity card number, reference indication of the plot of land for which he must obligatorily have occupation rights, the number of children and their ages.

Scope of the contract:

The purpose of this contract is to define the obligations between the project .... and .....(the farmer) for the setting up of one or more rubber planting trial plots.

Obligations of A:

1. Free supply of the plants required to set up the trial.
2. Supply of fertilizers for trial management in compliance with the trial protocols established and contained in the annex to this contract.
3. Payment, after completion, of the sum of ..... per planting hole.
4. Supply of fungicides, insecticides and herbicides for plant protection and upkeep, for three years starting from planting.
5. Provision of technical support for all agricultural operations for the duration of the project.

Obligations of B:

1. Provide the project with proof of land occupation rights for the plot, a copy of which shall be affixed to this contract..
2. Ensure land preparation.
3. Carry out holing.
4. Carry out planting and replacement of dead plants.
5. Carry out all the cultivation operations in compliance with the protocol in the annex, and follow the recommendations of project technicians.
6. Authorize access to the plot by project technicians, so that they can take the necessary measurements throughout the duration of the project.
7. Only start tapping the plot on the advice of project technicians.
8. Not to sell the plot in which the trials have been set up without prior agreement from the project and, in that case, reimburse the project for the cost price of the plants used.

Settlement of disputes:

- In the event of a disagreement between the parties during the performance of this contract, the two parties hereby agree to meet without delay to seek the most appropriate solutions for settling the different issues.

- As a last resort, the issue will be submitted to the local legal authorities.

Start date: This contract shall come into force on the date of signature by both parties.

Number of copies:

Addressees :
Annex: Trial Protocol, Plot land deed.

PERFORMANCE TRIAL

1. Purpose of the trial

By setting up a network of simple clonal trials in a widely varying range of agro-climatic situations, the aim of these trials is to study the performance of new high-yielding clones on smallholdings.

2. Planting material – clones tested

Each trial comprises 3 to 5 clones with known agronomic characteristics, using GT 1 or RRIM 600 as the control:

GT 1 reference clone, hardy, planted on a large scale in most producing countries.
conventionally used as a control in clone comparative trials, moderate growth and production, good hardiness, susceptible to *Colletotrichum*

RRIM 600

Stump in polybag with 1 whorl.

3. Experimental design – Trial size

Each trial consists of 3 to 5 elementary plots (1 plot per clone) without replicates.

Design - densité :	planting in rows, spacing 7 x 2.5 m, i.e. 571 plants / ha
Elementary plot:	5 rows x 32 planting holes = 160 plants (maybe modified depending on the configuration of the fields chosen)
Trial size:	15 to 25 rows x 32 planting holes = 480 to 800 plants, i.e. 0.84 to 1.40 ha

4. Upkeep

Fertilization and cleaning of planting rows, as per project norms

Interrow:	free for uniform intercrops, planting and upkeep costs to be covered by the farmer.
Mulch :	at the beginning of the dry season, with intercrop residues.
Sucker removal:	regular pruning of rootstock suckers (twice a month for the first 6 months).

5. Checks

Flushing - mortality:	count number of plants with whorls/without whorls/dead plants, twice a month for the first 3 months after planting, then
Growth:	once a year, in March-April circumference 1.50 m from the ground, starting in year 2
Intercrops:	recording of the crops grown (type, varieties used, planting date, quantities of inputs, harvest dates, estimation of the yields obtained).

FERTILIZATION OF IMMATURE TREES

1. Purpose of trial

The aim of this type of trial is to determine the economically optimum level of fertilization in the immature period, under different growing conditions (soil type, previous crops).

2. Treatments

T1 Half the standard rate up to opening
T2 Project control, standard fertilizer rate up to opening
T3 Double rate up to 4 years, then possible halt, depending on growth.

3. Planting material

Clone: GT 1 (choice No. 1) or RRIM 600 depending on availability of budwood.

Stump in polybag with one leaf whorl.

4. Experimental design – Trial size

Each trial consists of 3 elementary plots (1 plot per treatment) without replicates.

Design - density: planting in rows, spacing 7 x 2.5 m i.e. 571 plants / ha

Elementary plot: 5 rows x 32 planting holes = 160 plants (maybe modified depending on the configuration of the fields chosen)

Trial size: 15 rows x 32 planting holes = 480 plants, i.e. 0.84 ha.

5. Upkeep

Fertilization and cleaning of the planting rows: as per project norms.

Interrow: free for intercrops, planting and upkeep costs to be covered by the farmer.

Mulch : at the beginning of the dry season, with intercrop residues

Sucker removal: regular pruning of rootstock suckers (twice a month for the first 6 months).

6. Checks

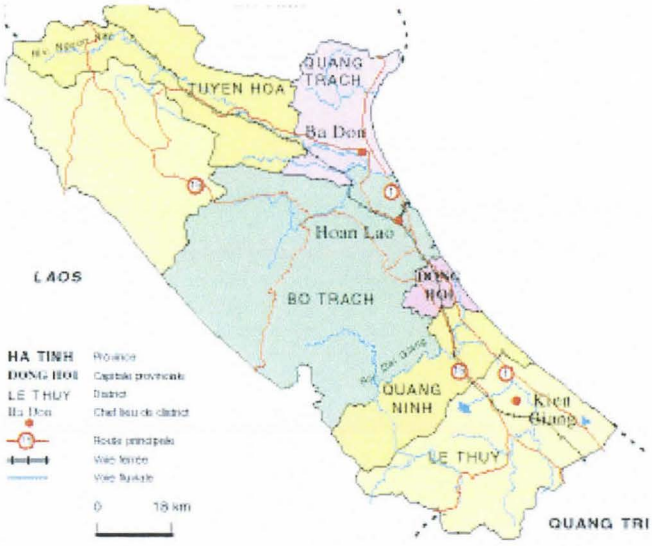
Flushing - mortality: counting of the number of plants with leaf whorls /without leaf whorls / dead plants twice a month for the first 3 months after planting.

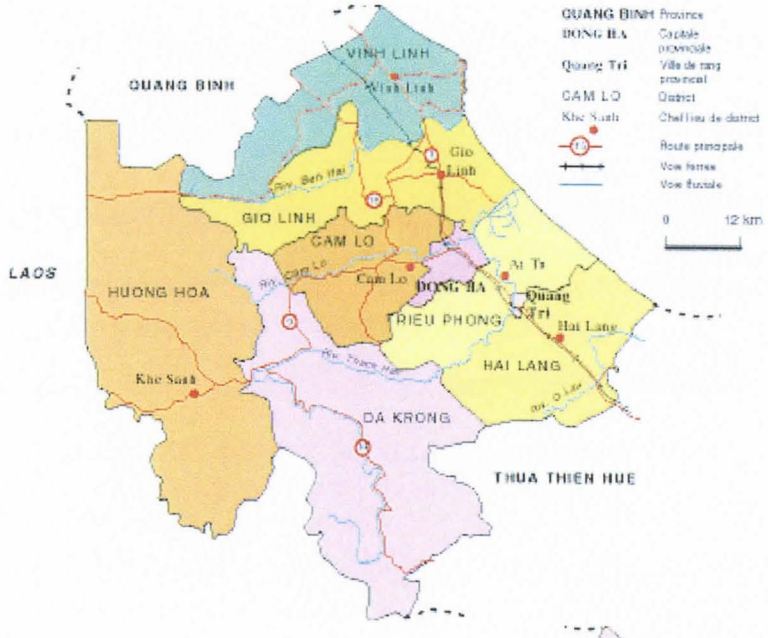
Growth: once a year in March-April
height to within 10 cm (at 1 year) then circumference 1.50 m from the ground starting in year 2

Intercrops: recording of crops grown (type, varieties used, planting dates, quantities of inputs, harvest dates, estimation of yields obtained).

Annex 9

Maps of the coastal provinces visited





Maps of the central provinces visited