

Evaluation and capitalisation Series



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Developing Smallholder Rubber Production

Lessons from AFD's Experience

Jocelyne Delarue, Evaluation and Capitalisation Unit, AFD

Research Department

Evaluation and Capitalisation Unit

Agence Française de Développement
5, rue Roland Barthes 75012 Paris < France
www.afd.fr



Foreword

The “Evaluation and Capitalization” series comprises works of retrospective analysis of development policies and interventions in which the AFD has participated

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Director of publication: Jean-Michel SEVERINO

Editorial Director: Jean-David NAUDET

ISSN: 1958-590X

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Page Layout: Marcelle LARNICOL

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Introduction

This evaluation aims to learn lessons from AFD's intervention methods to support the development of smallholder rubber plantations.

It is based on a review of AFD's projects in three main intervention countries in this sector: Vietnam, Cambodia and Ghana. Additional insight is provided by an analysis of the smallholder rubber plantations that AFD supported in the 1990s in Côte d'Ivoire and Guinea, and of Thailand's policy in favour of smallholder rubber plantations.

Despite different national contexts, the projects in Vietnam, Cambodia and Ghana generally shared the same objectives: to allow family farmers to establish rubber plantations and the States to develop their natural rubber exports and reduce poverty.

The type of support provided to farmers was also quite similar:

- (1) technical advice on planting and inputs,
- (2) credit for investment and plantation maintenance, and
- (3) support for the formalisation of land titles for plantations.

However, the projects were implemented in very different ways:

- in Vietnam, AFD intervened between 1998 and 2007 in the framework of an Agricultural Diversification Programme cofinanced with the World Bank in 12 provinces. Technical support was managed by a programme entity from the Ministry of Agriculture, and the line of credit was entrusted to the Vietnam Bank for Agriculture and Rural Development (VBARD);

- in Cambodia, AFD financed just one project in two provinces between 1999 and 2007. The project entity was managed by the Ministry of Agriculture with support from resident French technical assistance; a credit line was managed by the project entity in partnership with the Rural Development Bank (RDB);

- in Ghana, AFD has been financing a contractual agricultural project since 1995 involving the private company Ghana Rubber Estate Limited (GREL), which provides technical assistance for the development of village rubber plantations around its industrial hub and enjoys a monopoly for the purchase of production. National banks in Ghana grant loans to the planters. A producers' organisation defends the interests of planters.

This capitalisation of experience is based on a comparative analysis of these three types of implementation and aims to identify the advantages, constraints and limits of each of the approaches.

After a brief review of AFD's interventions to support the rubber industry, the project outcomes in the three main intervention countries are presented. The analysis then focuses on the targeting of beneficiary populations and the impacts of these projects on family farmers. To conclude, the sustainability of the various services implemented by these projects will be discussed.

1. AFD's interventions to support rubber plantations

1.1 Evolution of AFD financing for rubber plantations

Until 1995, agro-industrial projects were the most prevalent

The period from 1985 to 1994 is characterised by the increasing difficulties of these State companies in the rubber industry in the face of a deteriorating economic environment. Throughout this period, world prices for natural rubber experienced a lasting slump (except for 87-88), while the FCFA was overvalued. The World Bank consequently pushed for liberalisation and pulled out of financing the agro-industrial sector in general.

CFD, on the other hand, attempted to support these State companies through financial restructuring operations. In the mid-1990s, it was observed that these support measures had not led to conclusive results and CFD thus gradually abandoned them. Privatisation went smoothly in Côte d'Ivoire, but proved more difficult in Cameroon and Gabon.

Donors then began to take an interest in family rubber plantations, particularly in Côte d'Ivoire, where the World Bank, the Commonwealth Development Corporation (CDC), and then CFD supported their development from the late 1980s. The most common pattern involved entrusting a private company with the development of family rubber plantations on the periphery of industrial plantations. CFD consequently financed projects involving the companies SAPH and SOGB in Côte d'Ivoire.

A new wave of projects at the end of the 1990s

From 1995 to 2007, AFD and PROPARCO's commitments to rubber plantations were no more than 76M euros.

The three main rubber industries financed by CFD in the 1980s and 1990s in Côte d'Ivoire, Gabon and Cameroon completely disappeared from AFD's portfolio in the 2000s. This situation can, of course, be explained by the crisis in Côte d'Ivoire. In Cameroon and Gabon, delays and difficulties in privatising State companies hampered the preparation of new projects. One project to develop family plantations in Cameroon was assessed in 2003 and then cancelled.

¹ 2005 constant euros.

² Idem.

Table 1. AFD financing to support rubber plantations 1993 – 2009

Project ID	Project name	Country	Allocation date	Net commitments (constant €)	Net commitments (2005 €)	IPs (areas planted in ha)	VPs (areas planted in ha)	AFD share/total project cost
AFD								
CGH1018	Small rubber planters	GHANA	24/12/1993	1 168 979	1 410 912	0	1 200	u/a
CKH1010	Restructuring rubber interim phase	CAMBODIA	30/12/1994	1 466 560	1 741 220	0	410	u/a
CVN1024	Village rubber plantations, southern central plateaus	VIETNAM	22/04/1998	15 244 902	17 100 000	0	30 000	20.09 %
CGH1050	Small rubber planters	GHANA	15/12/1998	5 945 512	6 669 000	0	1 500	80.41 %
CKH1044	Village rubber plantations	CAMBODIA	18/02/1999	1 929 242	2 151 350	0	1 010	92.00%
CVN1045	Industrial rubber, Highlands	VIETNAM	07/07/1999	27 471 002	30 633 653	26 000	0	42.91%
Subtotal 90s				50 590 658	56 554 003			
CKH1068	Interim project to develop smallholder rubber plantations	CAMBODIA	24/04/2003	3 500 000	3 636 500	0	1 500	81.98%
CKH3000	Natural rubber (Trade capacity-building programme)	CAMBODIA	01/10/2003	800 000	831 200	0	0	91.00%
CGH6008	Perennial crop project (incl. rubber)	GHANA	17/11/2005	8 620 000	8 620 000	0	7 000	43.31%
CKH6006	Transition project to support smallholder rubber plantations	CAMBODIA	15/05/2007	840 000	813 960	0	4 000	72.00 %
Subtotal 2000's				13 760 000	13 901 660			
PROPARCO								
PC11049	SAIBE (rubber factory investment)	COTE D'IVOIRE	27/10/1995	533 572	623 000	u/a	u/a	u/a
PCM1067	HEVECAM (partial financing investment)	CAMEROON	02/07/1997	2 286 735	2 580 000	u/a	u/a	u/a
PLR1001	LAC smallholder rubber plantations	LIBERIA	29/04/1999	2 657 555	2 963 511	u/a	u/a	u/a
Subtotal PROPARCO				5 477 862	6 166 511			
TOTAL AFD + PROPARCO				69 828 520	76 622 174			
PROJECTS CANCELLED								
CCM 6003	HEVECAM - Village plantations	CAMEROON	Cancelled (2003)	7 000 000		0	3 063	82.35 %
CVN 6004	GERUCO - Viêt Lao rubber	VIETNAM	Cancelled (2007)	15 800 000		10 000	0	61.00 %
CLR 3000	LAC - Industrial and village plantations	LIBERIA	Cancelled (2007)	14 500 000		2 000	3 000	71.78 %
CKH ...	PNHF - National Family Rubber Plantation Programme	CAMBODIA	Cancelled (2008)	-		-	-	-
PROJECTS IN PREPARATION								
CNG 3000	SIPH - Village rubber plantations	NIGERIA	Preparation (2006)	7 000 000		0	5 000	63.64 %
CKH 1079	SOCFIN-KCD project to support smallholder rubber plantations	CAMBODIA	Preparation (2008)	2 500 000		0	2 000	?
CVN 6003	Village rubber plantations	VIETNAM	Preparation (2008)	29 000 000		0	0	62.77 %
CGH 1094	Non-sovereign support to village rubber plantations	GHANA	Preparation (2009)	25 000 000		0	10-15 000	

Source: AFD, 2009.

AFD financing of the rubber industry during this period in fact only concerned three new intervention countries: Vietnam (68% of net commitments), Ghana (22%) and Cambodia (10%), for an amount totalling €70 million. AFD mainly financed family plantations, except for one project to develop the industrial plantations of the State company GERUCO in Vietnam, and a Trade Capacity Building Programme (TCBP) for the natural rubber industry in Cambodia. Three projects prepared in 2008 also concerned smallholder rubber plantations in Nigeria, Cambodia and Vietnam for an amount totalling €40 million.

The financing of industrial plantations has consequently practically disappeared from AFD's portfolio for the moment, except for a few recent attempts to prepare projects. In the 1990s, PROPARCO financed three private natural-rubber-producing companies in Côte d'Ivoire, Cameroon and Liberia.

The first reason for the absence of new financing for the agro-industry can be explained by the fact that in most countries land conflicts with neighbouring populations are now tending to emerge with the creation of new industrial plantations. In Ghana, the company GREL consequently decided not to extend its private plantations—even on the land located within

the concession that it was legally entitled to—and in 1992 had to hand over to traditional family authorities the land that had not been planted. More recently, in Liberia the resumption of activities by the LAC company at the end of the war led to an upsurge of conflicts with local populations. In Lao PDR and Cambodia, new land for rubber plantations was made available by the State to agro-industrial groups for a maximum of 99 years, but the the question of native populations was again a sensitive issue. Two projects to finance the extension of industrial plantations were prepared by AFD and were subsequently cancelled (CVN, 6004 and CLR, 3000), partly due to the risk of negative social impacts.

Most of the agro-industries are now renewing their ageing plantations, which could in principle benefit from non-sovereign AFD financing. However, it seems that the high rubber prices of these past years are allowing some companies to finance their development out of their own funds. In Cambodia, the company SOCFIN-KCD has for the moment declined the financing offer made to it for setting up its industrial plantations or its factory.

AFD's main operations in this sector consequently focus on the development of family rubber plantations.

1.2 Objectives and frameworks for implementing projects to support smallholder rubber plantations

Objectives

Three objectives are set out in the notes to AFD's Boards:

- to contribute to increasing natural rubber production and exports in countries with high smallholder rubber plantations potential;
- to combat poverty in rural areas by intervening in poor regions and providing farmers with a new source of income and employment through smallholder rubber plantations;
- to promote reforestation in deteriorated areas and possibly contribute to carbon storage.

Through these rubber projects, the three objectives aim to further AFD's three main orientations: to support economic growth, combat poverty and protect global public goods.

These projects were programmed in countries where a natural rubber producing industry already existed, thus providing an agro-industrial outlet for future village production. They aim to develop production by encouraging farmers to use some of their land for rubber plantations, and to enable them to benefit from the existence of this industry.

The advantages that farmers should benefit from are mainly economic. The economic calculations made during the AFD

project appraisal phase show that rubber plantations are profitable, even when international prices are relatively low (\$1/kg), because they entail low costs and workloads during the exploitation phase. The life span of plantations (up to 30 to 40 years of exploitation) and their resilience when a holding is temporarily abandoned constitute additional advantages for family farmers. For AFD, the widespread rural poverty and these economic arguments are adequate justification of the “pro-poor” character of smallholder rubber plantation projects. However, the investment required and the lengthy immature period of rubber growing are strong constraints that the projects aim to mitigate.

The projects are mainly intended to reach “small-scale farmers”: in Cambodia, the farmers targeted each have a total land area of under 5 ha; in Vietnam, the project aims to support “poor farmers, particularly those that belong to ethnic minorities”; in Ghana, the project aims to increase farming incomes in one of the country’s most disadvantaged regions by developing rubber plantations each covering 4.5 ha at most so as to ensure that the project’s benefits are more widely distributed.

However, the innovative character of smallholder rubber plantations means it is necessary to prove to those farmers capable of taking risks what the benefits of smallholder rubber plantations are. The quantitative objectives of the areas planned for the first years of the projects were matched with a lower targeting of beneficiaries.

Institutional frameworks

In Ghana, the project started up in 1993 in line with the farmers’ movement, which was demanding and obtained the return of land that had not been planted by the GREL company (natural rubber producer) in order to create family rubber plantations. The project was naturally based on a contractual framework between GREL, a bank (the Agricultural Development Bank [ADB], the National Investment Bank [NIB]) and the farmers for the development of plantations on the periphery of the processing factory.

In Vietnam, the situation was very different in 1998 when AFD’s financing to support village rubber plantations fell within a framework of a World Bank programme to diversify agricultural produc-

tion in 12 provinces. Despite the fact that GERUCO was established in these provinces, the World Bank decided to design a programme mainly based on State departments and the Vietnam Bank for Agriculture and Rural Development (VBARD). Technical assistance from GERUCO, however, turned out to be indispensable due to the lack of other national competences in smallholder rubber plantations.

Finally in Cambodia, AFD started a project in 1999 in a province where rubber growing was also familiar but with a history of failure since the few former family and private plantations had been incorporated into the public industrial domain without the owners receiving compensation. However, the project did gradually manage to overcome the strong reluctance of the farmers and the administration. As we shall see, the absence of private actors to provide the services necessary for developing family rubber growing meant the project had to be based entirely on a project entity financed by AFD, including the loan component.

Intervention method

Despite these differences, the interventions have many common points that are determined by the distinctive characteristics of rubber plantations: the high cost of establishing a plantation, the technicality involved, and the lengthy immature period prior to production start-up (6 to 8 years). These are the obstacles that farmers must be helped to overcome.

These obstacles are addressed via the implementation of specific long-term lines of credit (20 years on average, with an 8-year grace period) to finance plantations. Support measures are required for the banks involved due to the specific nature of the loan product. This includes formalising land guarantees, which meant that all the projects thus financed land survey and registration components. Table 2 shows that the credit line (earmarked for “physical components”) accounts for a considerable share of the financing for the AFD projects.

Table 2. Share of the credit line in the smallholder rubber plantation projects

Financing	Share of the rubber credit line / total project cost *	Share of the rubber credit line / AFD financing*
Vietnam (CVN 1024)	53 %	64 %
Vietnam (CVN 6003)	42 %	67 %
Cambodia (CKH 1044)	28 %	30 %
Cambodia (CKH 1068-6006)	38 %	47 %
Ghana (CGH 1050)	29 %	40 %
Ghana (CGH 6008)	43 %	63 %

* in the initial project design, not the share of amounts actually disbursed
 Source: AFD, author's calculations.

In Ghana and Vietnam, AFD's financing is in the form of a loan to the State. The credit line is then reallocated as a loan in local currency or in euros (only CGH 6008) by the State to a retail bank. The State generally bears the exchange risk, but takes a margin on the loan allocated by AFD.

In Cambodia, the State received a grant to finance family rubber plantations. The credit line was onlent to a bank in the form of a zero-per-cent loan repayable by transfer to an institution "specialised in the long-term financing of smallholder rubber plantations in Cambodia" or was otherwise non-repayable.

In addition, the guarantee of high income (and of the repayment of loans) could only be achieved by targeting a good technical performance from the plantations: the projects consequently financed research-action components to develop technical recommendations for the villages, as well as close technical support from advisors specialised in rubber growing.

Figure 1. The various services provided by smallholder rubber plantations projects



Source: the author.

The projects in Vietnam and Ghana also included financing for some rural feeder roads to plantations, but this was limited due to World Bank orientations to support the planning of rural roads at the national scale.

2. Implementations in line with objectives

2.1 Areas planted within the projects

In AFD's three intervention countries, after a slow start-up phase, requests for support finally exceeded targets (cf. Table 3).

Table 3. Areas planted by the projects
(in accumulated ha, year-end 2007)

2007	Cambodia	Vietnam*	Ghana
No. of beneficiaries	1 012	27 452	2 121
<i>planned areas</i>	<i>3 500</i>	<i>47 000</i>	<i>6 300</i>
created with a loan	2 713	38 341	7 054
created without a loan	1 108	2 699	0
Total areas (ha)	3 821	41 040	7 054
% planted	109	87	112
% areas with loans	71	93	100

* including rehabilitation

Source: Cambodia - PHF, 2008; Vietnam - FAO, 2007; Ghana - GREL, 2008.

The pace at which family producers established smallholder rubber plantations was strongly related to the rise in world rubber prices in the mid-2000s. It was the examples of incomes from village plantations already operating that certainly encouraged the farmers to become rubber growers. These plantations were either very old (cooperative plantations from the 1960s in Ghana, Programme 327 plantations in Vietnam), or newly planted by the first growers from projects financed by AFD. In Cambodia, the liberalisation of the collection and processing of natural rubber and the setting up

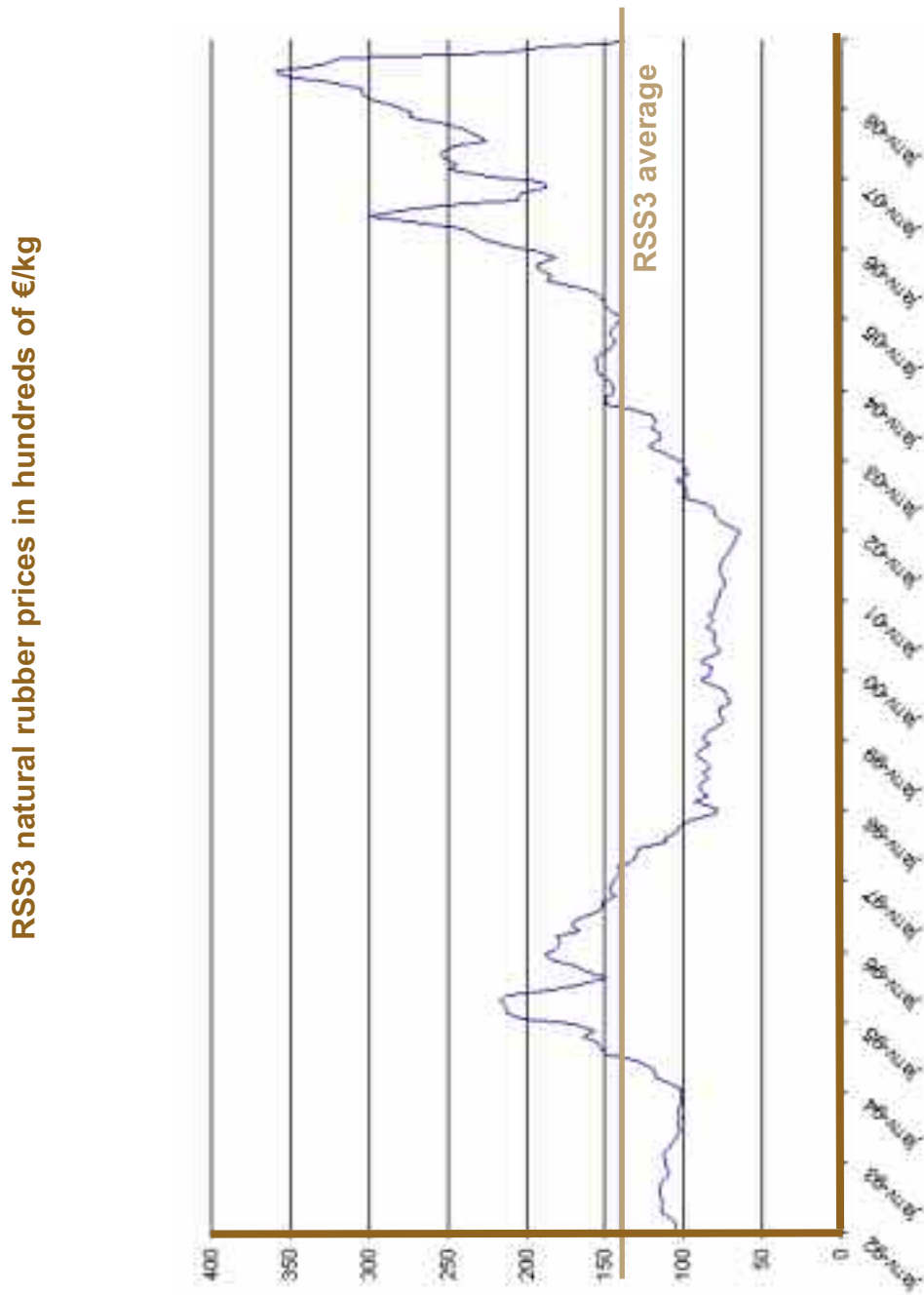
of new factories from 2004 onwards helped to drive the rise in prices offered to farmers and raise their interest in rubber plantations.

Box 1. Trends in world natural rubber prices

AFD's projects were designed in a context of low rubber prices on the world market (Figure 2), but with optimistic forecasts for future price trends. A deficit in natural rubber was forecast for the international market in the mid-2000s, spurred by rising demand from emerging countries (increase in the number of vehicles and consequently tyres) and insufficient supply from the traditional producer countries (ageing plantations in Malaysia and Indonesia in particular). These forecasts proved to be true in the short term, with a sharp rise in prices from mid-2005 onwards.

The dramatic fall in prices from July to December 2008 cannot yet be completely interpreted as a long-term reversal of the trend. However, the effects of the crisis on the demand for tyres and low oil prices are factors indicating that a rapid rise in the price of natural rubber is unlikely.

Figure 2. World price trends for RSS3 rubber between 1992 and 2009



Source: National Syndicate for Rubber and Polymers and IRSG, 2008.

2.2 Large cost variations for establishing plantations

The project documents estimate the theoretical cost of a rubber plantation at between \$1,076 and \$2,187/ha, if the planting is carried out professionally by the farmer. The SAPH in Côte d'Ivoire estimates this cost at \$2,442/ha.

As it is planned that each farmer plant between 2 ha (Vietnam) and roughly 4 or 5 ha (Cambodia, Ghana), each household will need to mobilise between \$4,000 and \$10,000 over a two- or three-year period. Given the scale of this expenditure, the projects had planned to cover most of this outlay by the allocation of a loan (Table 4).

In fact, as can be seen in Table 3, 71% of the areas in Cambodia, 93% in Vietnam and 100% in Ghana were created with the help of loans.

However, the real expenditure paid out by the planters (when it was possible to assess this), turned out to be substantially different from the ex ante estimations.

The difference between the estimated cost and the real cost is striking in Vietnam. Surveys conducted by GRET show that farmers create plantations at a cost from 50 to 75% lower than the theoretical cost.

Table 4. Theoretical costs and loan financing per hectare of rubber planted

constant \$/ha	Cambodia	Vietnam	Ghana	Côte d'Ivoire
Cost of labour	186	437	459	
Cost of inputs	890	1 750	1 721	
Total	1 076	2 187	2 180	2 442
<i>Including financing by loan</i>	<i>811</i>	<i>1 750</i>	<i>1 904</i>	
% costs financed by loan	75	80	87	

Source: author's calculations.

Table 5. Real costs of a rubber plantation

\$/ha	Cambodia	Vietnam (Hué)	Vietnam (Kontum)	Ghana	Côte d'Ivoire
Cost of labour	387	235	228	459	706
Cost of inputs	719	781	283	1 704	424
Cost of land	10	0	0	17	0
Total net cost	1 116	1 016	511	2 180	1 130
Reminder of estimated cost	1 076	2 187	2 187	2 180	2 442

Source: author's calculations.

Table 6. The cost of planting material (PM)

\$ / unit	Cambodia	Vietnam	Ghana	Côte d'Ivoire
Stump	-	0.25	0.69	-
Young plant in bag	0.3	0.92	-	0.60
Young plant grafted in nurseries	-	-	-	0.48
Total cost \$/ha (600 u.)	180	150	414	288
% PM cost/total cost	16	15	19	25

Source: author's surveys.

This difference can be explained by several factors:

(i) the planting material used is of a lower quality than in the other projects (stumps³) and is less expensive (Table 6);

(ii) the technical supervision of producers is not intensive in this programme: the producers are not obliged to follow the recommended technical itineraries;

(iii) finally, the farmers are free to purchase the quantities of agricultural inputs they want and in some provinces (Kontum) they must prefinance them before being reimbursed by the bank upon presentation of invoices. They consequently limit their spending.

The low level of investment made by farmers, as is the case in Kontum Province, reduces the farmers' short-term risks but could have a considerable negative impact on yields and, consequently, the profitability of plantations. Measurements of the actual yields obtained by family plantations, with different levels of intensive planting, would provide valuable information, as this would allow the technical itineraries recommended by the projects to be modified and made more affordable for farmers.

In Côte d'Ivoire, planters no longer receive project support and finance their plantations with their own resources. They devote a large part of the funds to purchasing grafted planting material (25% of the total cost), but also make savings elsewhere by using family labour for the work and by limiting agricultural inputs.

Costs observed in Ghana are the same as the those estimated in the project documents because: (i) inputs are sold to the farmers by GREL at the price listed in the project feasibility study; (ii) the application of the technical itinerary is controlled by the project technicians and (iii) the cost of labour in phase III of the project was defined by observing the practices of planters in phases I and II. This leads to a unit cost for planting

and a loan amount that are much higher than in the other projects. Applying the costs defined in the feasibility study tends to freeze the price billed to planters, who thus do not reap the benefit of eventual price reductions: for example, in 2008 the planting material was probably overbilled⁴ (Table 6).

It was not possible to verify the source of the figures given for the actual costs of planting in Cambodia. They do, however, appear to be realistic and close to the costs initially estimated. Cambodian planters benefit from an indirect subsidy from the project for the cost of planting. This is because the project has developed its own nurseries that provide young plants at below market prices and deliver them to the planters (Table 6). The close supervision provided by the project, as shown by the high cost of technical assistance per hectare (Table 7), probably encouraged planters to apply the entire recommended technical itinerary.

Cost of project support

The creation of village plantations required the implementation of relatively heavy projects that provided close technical support.

In Vietnam, State departments implemented a programme in 12 provinces via a project entity. Its cost price per hectare is well below the 2 other projects and stands at only \$275: in fact, most of the staff belong to the civil service (Ministry of Agriculture) and their cost is not passed on to the project. It is worth noting that 53% of this cost concerns registration of parcels of land, which served as collateral for the loans obtained by the planters.

³ The main types of young plants grafted with clones are (i) plants in post-budburst phase (with leaves) delivered with their roots in bags; (ii) stumps (grafted saplings without leaves) in bags and (iii) bare stumps (grafted saplings without leaves and bare roots). Seedlings are plants that come from the germination of rubber seeds and are not grafted. They have diverse genetic characteristics.

⁴ The young plants sold by GREL to customers outside the project were also billed at a lower cost than those sold to project beneficiaries.

In Ghana and Cambodia, the projects respectively cost \$943/ha and \$1,363/ha. These cost prices would be comparable if the cost of technical assistance in Cambodia is factored out: the project in Ghana benefits from GREL's experience in rubber plantations. This cost is most likely not completely billed to the project since GREL itself benefits from the development of village plantations. In Cambodia, on the

other hand, it was necessary to develop the project ex nihilo.

The total cost of establishing a hectare of rubber consequently breaks down among the different actors as follows (Table 8). Cambodian planters benefit from a subsidy which amounts to 53% of the total cost, with 28% for Ghanaian planters and between 20 and 33% for Vietnamese planters.

Table 7. Detailed cost of project support

	Cambodia		Vietnam		Ghana	
	Cost \$/ha	%	Cost \$/ha	%	Cost \$/ha	%
Extension	395	29	62	24	333	35
Project management	174	13	29	11	141	15
Young plant subsidies	44	3	0	0	0	0
Land subsidy	3	0	135	53	0	0
Technical assistance	445	33	0	0	44	5
Support to FOs	74	5	0	0	127	13
Support to credit	228	17	0	0	0	0
Rural roads	0	0	16	6	274	29
Research	0	0	11	4	23	2
Support to minorities	0	0	4	2	0	0
TOTAL	1 363	100	257	100	943	100
% technical assistance		65		28		42

Source: Cambodia – PHF, 2008; Vietnam – FAO, 2007; Ghana – GREL, 2008.

Table 8. Total cost of establishing 1 ha and cost breakdown

\$/ha	Cambodia	Vietnam (Hué)	Vietnam (Kontum)	Ghana
Cost for farmers (excl. fin. charges)	1 116	1 016	511	2 180
Project costs	1 363	257	257	943
<i>from State</i>	4	257	257	684
<i>from donor</i>	1 311	0	0	44
<i>from private donor</i>	0	0	0	141
<i>from farmers</i>	48	0	0	74
Total	2 479	1 273	758	3 123
% subsidy for farmer	53	20	33	28

Source: author's calculations.

The cost of the subsidy given to farmers is borne differently among the actors and depends on the type of financing provided by AFD (grant or loan to the State) and the possible involvement of a private operator, as is the case in Ghana (Table 9).

Table 9. Breakdown of the subsidy paid to the planters

	Cambodia	Vietnam	Ghana
State	0.3 %	100.0 %	78.7 %
AFD and other donors	99.7 %	0.0 %	5.1 %
Private operator	0.0 %	0.0 %	16.2 %
Total	100.0 %	100.0 %	100.0 %

Source: author's calculations.

2.3 The quality of the plantations established

The quality of plantations established with close technical support from the projects in Cambodia and Ghana appears to be excellent (Table 10). Mortality remains low and 99% of the plants have been replaced. The targets for tapped and production areas seem to have been exceeded in 2007 (these figures are obtained from small samples).

The yields expected in Cambodia and Ghana are 1,800 kg/ha when production is up and running. They will probably be in excess of this figure on a number of holdings.

In Vietnam, due to more difficult climate conditions, the less strict application of technical itineraries, and the lack of systematic training in tapping after the ADP1 project, one cannot expect yields above the GT1 average in Vietnam, i.e. 1,260 kg/ha on average, or 1,400 kg/ha when production is up and running. The preparation of a new phase for the project will make it possible to resume the rubber tapping schools.

Table 10. Some indicators on the quality of plantations

	Cambodia	Vietnam (Hué)	Vietnam (Kontum)	Ghana
Mortality observed in the second year	16 %	15 %	37 %	1 %
replaced	15 %	12 %	33 %	-
not replaced	1 %	3 %	4 %	1 %
Mortality observed in year 6				6 %
Measurement of the circumference (cm)				
year 2	24			15
year 3	32.5			20
year 4	41.2			25
year 5	44.7			35
year 6	47.8			41
% area actual tapped / target	-			137
Expected yield when up and running	1 800	1 400	1 400	1 800
% actual yield / target	138			106

Source: Cambodia – PHF, 2008; Vietnam – GRET, 2008; Ghana – GREL, 2008.

2.4 Profitability of rubber plantations

The profitability of rubber plantations is, of course, linked to the cost of establishing and maintaining the plantation, the yield, operating costs, the price obtained during the exploitation phase, the working time spent on the plantation and, finally, the loan repayments.

Cost of establishing a plantation

As we have seen above, the actual cost of establishing and maintaining a plantation varies enormously from one country to another. It stands at \$1,116/ha in Cambodia, ranges between \$511 and \$1,016/ha in Vietnam and reaches \$2,180/ha in Ghana. The reasons for these differences are explained in section 2.2.

Yields

The expected yields in the different countries (Table 10) are linked to both the expenditure made to establish the plantation (quality of young plants, quantity of fertilizer applied, maintenance of the plantation...) and the quality of technical advice given to the farmer. The latter is partly related to the project cost.

It is worth noting at this stage that the yields also depend heavily on the quality of the tapping carried out by the farmers. In Ghana, where GREL continues to supervise the farmers during the exploitation phase, training in tapping is provided. However, in Vietnam and Cambodia, projects do not last long enough for the farmers to be supervised at this stage. It is therefore necessary for the project phases to follow on from each other in order to provide this essential training, as is the case in Vietnam. Otherwise, a solution needs to be reached with the public authorities, as is the case in Cambodia where the General Directorate of Rubber Plantation (GDRP) will support planters' organisations for the creation of rubber tapping schools. In Guinea and Côte d'Ivoire, the tappers are generally employees of the planter: they initially worked on plantations of the agro-industries and then find higher salaries with the family planters.

Price paid to family planters

The past few months (end of 2008 to early 2009) have been marked by a sharp fall in the price of natural rubber after an unusual rise during the first half of 2008 (Figure 2). It is likely that this type of fluctuation—which has already been seen in the past—will happen again in the future, perhaps to a lesser extent, depending on the price of oil and the demand for tyres which in turn is linked to global economic growth.

The trend for world market prices averaged roughly \$1.43/kg for the RSS3 quality rubber between 1992 and 1998. Recent World Bank forecasts expect prices to remain above this historical average in the coming years (2010-2020 forecasts). We will therefore use this average in the profitability calculations below.

Farmers receive a variable share of the FOB price charged in each country, which itself varies according to international prices. The prices below (Table 11) are calculated for Cambodia and Vietnam using the results of field surveys⁵. In Côte d'Ivoire and Ghana, the prices for producers are linked to international prices by a formula negotiated between exporting companies and planters' associations.

Table 11. Share of FOB price paid to family planters

\$/T	Cambodia (02/08)	Vietnam (2007)	Ghana (03/08)	Côte d'Ivoire (07/06)
FOB TSR 10 and 20		2 230	2 630	2 239
FOB off latex	2 600	-	-	-
DRE field	1 900	1 534	1 482	1 311
Share FOB	73 %	69 %	56 %	59 %
Share world prices	?	-	55 %	57 %

Source: author's surveys.

⁵ Unfortunately, the project to support the certification and marketing of rubber in Cambodia financed by AFD (CKH 3000 01 D) did not include the monitoring of price forecasts in its objectives.

Cambodia is the country where the planters receive the highest percentage of the FOB price (73%). This undoubtedly stems from processing overcapacity in the rubber industry and the competition between companies to buy village production. However, Cambodian exports do not follow the formal world market channels and the FOB price may be lower than the international price.

In Vietnam, the percentage of the FOB price obtained by producers is also high (69%) due to competition between buyers and the market in nearby China.

In Ghana, the price mechanism sets the purchase price for dry rubber from the producer at 62% of the FOB price. However, contributions made for financing advisory services, for the planters' association and for a contingency fund mean the end amount received stands at only 56%, in return for the services provided. In this price mechanism, the conversion rate from latex to dry rubber seems somewhat low, but this is currently under inspection: GREL recently suppressed a 3% discount on the international price that has long been applied to African rubber.

Finally, in Côte d'Ivoire the price is also determined by a mechanism negotiated between all the companies and the producers' association. This results in a share of the FOB price and the international price that is slightly higher than in Ghana (57%).

We can thus estimate that the prices paid to producers in the future will remain at around \$0.77/kg (55% of \$1.4/kg).

Work on the plantation and operating costs

The time spent working on the plantation and on maintaining one hectare of rubber varies according to the soil preparation (is the land already farmed, fallow land, or a plantation that needs clearing?) and the application of the technical itinerary (amount of weeding, pruning, etc.). We will use the estimation of the feasibility study for the new project in Vietnam (ADP2) for an average technical itinerary: a total of between 258 and 298 man-days (md)/ha (cf. details in the appendix).

In terms of tapping, the required labour time depends on the frequency of tapping per week (1d/2, 1d/3 or 1d/4), as well as the collection system, which requires more work when latex is delivered every day and less when production is delivered in the form of coagulum. On this basis, we will consider that one full-time worker is required to exploit 4 ha of rubber.

The share of this work carried out by day workers is counted in the operating costs.

Financial costs

The terms for granting loans in the framework of the different projects varied considerably.

For all the projects, the total loan amount was defined so as to cover the bulk of the monetary investment in the plantation (including the maintenance years): the loan covers all the cost of inputs (fertilizer, young plants, antifungicides), and the cost of the contractual labour. However, depending on the country, it either does or does not cover the cost of family labour, technical advice and the creation of a land title, as summarised in Table 12.

Table 12. Costs of establishing a plantation that are covered by the loan

Country	Inputs	Contractual labour	Family labour	Technical advice	Land title
Vietnam (CVN 6003)	yes	yes	sometimes	no	no
Cambodia (CKH 6006)	yes	yes	no	partly	yes
Ghana (CGH 6008)	yes	yes	yes	no	yes

Source: author's surveys.

Table 13. Loan terms for rubber farmers

	Cambodia		Vietnam (Hué)	Vietnam (Kontum)	Ghana	Côte d'Ivoire
Max. amount (\$)	1 000 \$	eq. 730 \$	eq. 1 700 \$	eq. 1700 \$	eq. 1 900 \$	
Currency	Dollar	Riel	VND	VND	Cedis	CFA
<i>Interest rate</i>	7	9	9.72	9.72	11.50	7.00
<i>Maturity (years)</i>	20	20	20	20	22	18
<i>Grace period (years)</i>	10	8	8	8	8	7
Amount borrowed for rubber	557	557	1 016	511	1 904	-
Grace period (years)	6	6	8	8	8	-
Repayment period (years)	3	3	10	10	14	-
Financial charges	399	532	871	417	1 714	-

Source: author's surveys.

The differences also concern the financial conditions, which are linked to the type of intermediary involved.

In Cambodia, the loans were allocated by a project team. The Rural Development Bank (RDB) subsequently took charge of the credit line and is responsible for recovering loans but does not grant new loans. The maximum amount for a loan was \$1,000/ha at the beginning of the project and later \$730, granted in riels, in order to take account of the low amounts actually borrowed by the planters. The average amount borrowed by the planters was in fact \$557/ha. Most preferred to borrow in dollars and bear the exchange risk in order to benefit from the lower interest rate applicable under these terms (7% instead of 9%). Most planters prepay their loans as the production phase in Cambodia begins very rapidly. Despite the low rates and the early repayments observed during years when prices were high (2006-2008), the financial charges paid by Cambodian planters stand at 72% of the capital borrowed (Table 13).

In Vietnam, the Vietnam Bank for Agriculture and Rural Development (VBARD) implemented loans through its own officers. The credit line set up by AFD and the World Bank made it possible to limit the rates for planters to 9.72%. Once the credit line had been used up the bank agreed to continue financing the maintenance on the rubber plantations that had already been established, but at a higher rate. The financial

charges borne by the planters finally amount to roughly 83% of the capital borrowed.

In Ghana loans were allocated by the Agricultural Development Bank (ADR - a State bank) during the first phase of the project. Rates at that time stood at over 25% due to the high inflation in Ghana. During the second phase, the credit line was allocated to the commercial bank NIB following a bid invitation. This operation gave the NIB the opportunity to develop its rural client base in complete security. It sets its own rate of 11.5% a year for the loans granted. In these conditions, and despite prepayments by planters, the financial charges amount to 90% of the capital borrowed.

This clearly shows that when a financing institution such as the NIB is actually involved, credit terms are less favourable for the planters, but there is the advantage of possibly making the activity sustainable in the long term.

Overall cost

The following table summarises all the costs borne by the planters to establish one hectare of rubber. When financial charges are included, the differences become striking: whereas one hectare of rubber costs around \$1,650 for a Cambodian planter, it costs almost \$3,900 for a Ghanaian planter.

Table 14. Overall cost of a plantation (1 ha)

	Cambodia	Vietnam (Hué)	Vietnam (Kontum)	Ghana	Côte d'Ivoire
Total net cost of rubber plantation	1 116	1 016	511	2 180	1 130
<i>incl. financing by loan</i>	557	1 718	1 718	1 904	-
Financial charges for rubber	532	871	417	1 714	-
Total cost incl. financial charges	1 648	1 887	928	3 894	-
Self-financed share	50 %	-69 %	-236 %	13 %	100 %

Source: author's calculations.

The reason for these differences can be briefly outlined.

The cost for a Cambodian planter is lower for several reasons. The first is the low cost of inputs distributed to producers: the project itself created nurseries, sold young plants at cost price and also made pooled bid invitations for the other inputs. The project consequently indirectly subsidised part of the cost of the plantation. The Cambodian project is also characterised by an extremely low cost of borrowing, which would not be sustainable for the local banking institutions (see above). This low cost price for planters would thus seem to be entirely dependent on the existence of the project entity.

The cost for a Vietnamese planter is equivalent to the costs borne by Cambodian planters. In this case, the cost of inputs is higher as planters obtain them at a retail price from private suppliers, but the farmers apply fewer inputs due to the fact that they receive less supervision than in Cambodia. The cost of credit is close to that in Cambodia and is not in line with market practices: when the bank itself lends to the planters, it applies a higher rate. This set-up is therefore partly sustainable.

Finally, the cost for a planter in Ghana is more than double that for a Cambodian planter. The unit cost in euros for inputs was agreed with the operator, GREL, during the feasibility study and these are not supplied to the planters at cost price. Moreover, the loan covers a very sizeable share of the plantation costs (87%) and the interest rate is higher than in the two other countries. In these conditions, the partnership between GREL, the planters and the bank would generally appear sustainable and replicable.

Profitability

First, if we compare two 4-ha plantations that were established professionally in 2002 (one in Cambodia, the other in Ghana), all the conditions are the same except for the characteristics of the loans. We suppose that these plantations are established with subsistence intercrops. We can expect a yield of 1.8 t/ha when production is up and running. The yield will decrease from the sixteenth year onwards due to the decreasing density of trees on the plantation, and will continue to fall steadily until the plantation's fortieth year when the density will have reached 50%. We then suppose that the farmers will decide to cut down the plantation and sell the wood to a factory at \$2,000/ha.

With real prices from 2002 to 2008 and an average price of \$0.77/kg in the coming years, the results are as follows (Table 15).

Table 15. Economic results for a 4-ha rubber plantation

\$	Cambodia	Ghana
Total NAI* over 40 years for 4 ha	152 718.00	148 042.00
Average NAI/ha/p.a.	954.50	925.30
Average NAI/md	12.64	12.25

*NAI: Net Average Income

Source: author's calculations.

A 4-ha rubber plantation established in good conditions enables the farmer to obtain \$150,000 of net agricultural income over 40 years, i.e. roughly \$950 per hectare per annum. The rubber plantation also provides an income of over \$12 a day for family labour. The effect of the less attractive loan terms in Ghana would appear to be insignificant compared to the length of exploitation of the plantation.

3. Targets and impact

The aim of the projects to develop smallholder rubber plantations was to enable farmers to integrate natural rubber production industries in good conditions.

There was no specific targeting of certain categories of farmers in these projects, apart from in Vietnam where the project, cofinanced with the World Bank, focussed on support to poor populations and minorities. Overall, selection in these projects mainly involved excluding candidates with low chances of success. There were two types of selection: technical selection by the project and financial selection by the bank.

The project's technical selection of beneficiaries was designed on the basis of objective criteria relating first to the plot where rubber could be planted (total area available, slope, access, etc.) and, second, to the family holding (age of beneficiary, labour force...).

The selection for the allocation of credit was systematically entrusted to the banking entity partnering the project, or to a project team that was different from the technical team. There was thus an independent selection based on the farmers' repayment capacities. A guarantee from a formalised land title was systematically required.

In the early stages, when the projects were trying to demonstrate the advantages of planting rubber and having problems in finding a sufficient number of interested farmers, access to

the project was extremely open, although the selection criteria were still applied.

Production start-up in the first project-supported village plantations and the increase of natural rubber prices between 2001 and 2008 subsequently convinced the majority of farmers of the advantages of this crop. When requests exceeded the projects' offer, the decision was taken in most cases to limit the area allocated to each beneficiary by the project in order to give as many farmers as possible access to smallholder rubber plantations. Other farmers, who had not been selected or did not know about the project, began planting rubber without any support.

It thus seems crucial to ask the question: whom did our projects actually target? What was their additionality in terms of access to smallholder rubber plantations? Could other operating methods help a larger number of farmers?

More specific questions to be asked are:

- Who are the farmers that registered for the smallholder rubber plantations projects?
- Do the selection criteria applied exclude certain categories of farmers?
- What are the impacts of AFD's projects?

3.1 Socioeconomic profile of beneficiaries

3.1.1 Reasonably well-off to well-off family farmers

Within the framework of the projects, relatively few data have been collected on the socioeconomic profiles of planters. In addition, available information from specific surveys is difficult to compare from one country to another. However, a trend can be seen: projects to develop smallholder rubber plantations generally reach reasonably well-off to well-off families that have an above average total land area and sometimes have income from extra-agricultural activities.

Table 16 shows that poor farmers remain in the minority among project beneficiaries: they account for only 16% in Ghana, 18% in Vietnam and 29% in Cambodia. It is easy to understand that the most economically fragile holdings, or those with the least land, find it more difficult than the others to invest in these crops, which are difficult to plant and do not provide any income for 6 to 7 years. However, these figures show that project support was not specifically targeted at the less well-off categories with a view to enabling them to overcome such obstacles. It was, in fact, the reasonably well-off or well-off farmers who were the main beneficiaries.

In Cambodia⁶, rubber planters mostly belong to the category of average-sized or large holdings, where areas planted with perennial crops exceed the areas with annual crops. Over two-thirds of rubber planters have a total area of over 3 ha, while over 80% of Cambodian families have less than 2 ha of land. Almost all the rubber planters combine agricultural and non-agricultural activities (trade, transport, money-lending or even paid employment). The average area planted for each holding under the project amounts to 3.78 ha/planter and 37% of the project beneficiaries planted over 4 ha (Table 17).

In Vietnam⁷, the planters belong to holdings that already had above average land areas. The distribution of additional land for smallholder rubber plantations would appear to have first and foremost benefitted a multi-activity population that had previously had only a marginal agricultural activity. The poorest families with less land than the others did not plant rubber or planted it in very small areas. The average area planted by project farmers is 2.3 ha, but ranges between 0.1 and 11.9 ha.

Finally, in Ghana⁸, planters' families generally have large areas of available land because the production systems are still based on a combination of perennial plantations and subsistence production in rotation with long fallow periods. Farmers with less land can also access land on long-term leases, including for rubberwood planting. The average area of rubber per farmer tends to be over 4 ha, bearing in mind that the maximum area allocated by the project to each farmer is theoretically 4.5 ha. In 2004, 23% of project planters had over 6 ha of rubber (Table 17). There may also be more than one planter per household (the head of the family, his wife, and his children can be registered separately under the project).

Table 16. Poverty level of FP project beneficiaries

	Cambodia	Vietnam	Ghana
% poor	29	18	16
% average	13	77	59
% well-off	58	5	25

Source : Jacqmin (2004); Renard (2008); Horus (2005).

⁶ Jacqmin C., 2004. Analyse des systèmes agraires des districts de Chamcar Leu et Stueng Trang, Cambodge.

⁷ Renard, O., 2008. Enquêtes auprès des bénéficiaires de la composante "Développement des plantations d'hévéaculture villageoises" in the framework of the ADP1 project. GRET.

⁸ Horus, 2005. Feasibility study on rubber outgrower plantation project, phase 3 in the Western, Central and Eastern Regions of Ghana and Chambon, B., 2004, CIRAD.

Table 17. Distribution of areas financed by the projects

	Cambodia		Vietnam*		Ghana	
Average area	3,6		2,3		4,44 (3,3 end 2007)	
Standard deviation	3,6		0,1 à 11,9		2,47	
	Number	%	Number	%	Number	%
	of farmers		of farmers		of farmers	
0 to 1,99	396	34	-	-	-	5
2 to 3,99	341	29	-	-	}	72
4 to 5,99	199	17	-	-		
to 6 and over	238	20	-	-	-	23
Total	1 174	100	-	-	-	100

* new plantations only.

Source: Cambodia – PHF, 2008; Vietnam – Fao, 2007; Ghana – GREL 2008 and CIRAD, 2004.

Table 18 illustrates our schematic understanding, based on the limited data, of the characteristics of the typical holding of a rubber planter in each of the countries.

Table 18. Place of rubber in planters' holdings

	Cambodia	Vietnam (TTHué)	Vietnam (Kontum)	Ghana
Rubber area	3.6	2	1.6	3.3
Total area	7	2.7	2.7	20
Annual crops	0.4	0.7	0.6	1.3
Perennial crops (incl. rubber)	6.6	2	2.1	8.7
Fallow	0	0	0	10

Source: author's estimates.

3.1.2 Evolution of beneficiary profiles

Looking back after almost 10 years since the project start-ups, it is interesting to distinguish the first beneficiaries to adopt smallholder rubber plantations from those that registered for the project at a later stage.

In Cambodia, the first beneficiaries generally established large plantations with support from the project as they were above the average wealth level, had the capacity to take risks, and large areas of land. The selection of applications was not strict at start-up in order to meet the objectives for land areas set by AFD. On the contrary, for the two campaigns of 2006 and 2007, applications for larger areas of land were excluded for the benefit of smaller scale beneficiaries.

The same analysis also applies to Ghana. In addition, surveys conducted in 2003 in one village (Ruf, 2003⁹) show that the first rubber planters were mainly indigenous and above average age, both of these criteria meaning that they had a large amount of land. Moreover, they were often better informed about smallholder rubber plantations than other farmers (former rubber growers from cooperatives in particular). Those who had more recently taken up smallholder rubber plantations include younger and allochthonous populations, as well as women and the children of the first beneficiaries.

3.1.3 Beneficiaries' credit needs

Finally, the question can be raised as to whether the credit line actually allowed more farmers to plant rubber, as was assumed in project design.

Some farmers said that they could have established the same area of plantation without taking out a loan, but they remain the minority (Table 19).

Table 19. Proportion of beneficiaries in no real need of credit

	Cambodia	Vietnam (Kontum)	Vietnam (TTHué)	Ghana
% credit is main constraint	75	74	96	-
% not in need of credit	25	26	4	-

Source: Cambodia – GRET, 2006; Vietnam – GRET, 2008.

⁹ Ruf F., 2003. "Rubber in the Cocoa Belt. Ecological Change and Life Cycles towards Diversification", Manso Amenfi, Kpalimé.

Most planters, however, could have found resources to establish plantations without a loan from the project (Table 20). The farmers said that they would have made their investment gradually, on a smaller area, and would have limited their expenditure, to the detriment of the quality of the plantation. We make a comparison below of the profitability of rubber plantations with and without the project.

This type of information is consistent with the data showing that the project beneficiaries are not among the poorest. We shall see later that a large number of family rubber plantations were established spontaneously in Cambodia and Vietnam without any project aid. These results raise the question of the type of loan products that could be provided for smallholder rubber plantations in the future.

Table 20. Other financing options for rubber planting

	Cambodia	Vietnam (Kontum)	Vietnam (TTHuế)	Ghana
Other bank	-	22 %	39 %	-
Loan from family	-	14 %	32 %	-
Own resources	45 %	10 %	4 %	-
Sale of plot or other asset	-	8 %	0 %	-
Would not have planted without the project	25 %	38 %	25 %	-
Others	30 %	8 %	0 %	-
Total	100 %	100 %	100 %	-

Source: Cambodia – GRET, 2006; Vietnam – GRET, 2008.

3.2 Conditions of access to the project

The description of the socioeconomic profiles of the beneficiaries of the AFD projects shown above raises a number of questions concerning both the selectivity practiced by the smallholder rubber plantation projects, and their capacity to remove the barriers to adopting rubber cultivation for a large number of farmers.

3.2.1 Selection by the project

In the framework of AFD's projects, the entry point for becoming a "beneficiary" of a family rubber plantation project was to apply for a loan from the project for the plantation. The only exception was the Cambodian project, where loans were blocked in 2006 and 2007 due to problems in formalising land titles.

In all three projects, the beneficiaries were thus jointly selected by the project's technical team and by the bank or the credit unit. The decision to grant a loan was ultimately made by the bank, which, in all cases, bears the commercial credit risk.

The technical team first validated the feasibility of the plantation being established in good conditions, with positive future prospects for yields.

This technical analysis of the future plantation is in itself an initial guarantee for the bank as it ensures the potential profitability of the investment. Under the project, the banks' loan officers received training in the banking product offered (long-term loan) and the cultivation techniques for rubber planting.

In addition to this “technical guarantee”, the banks also sought additional guarantees.

In the three countries, the land title for the plantation was a second guarantee required by the bank. The time needed to obtain titles from the land registry meant that the banks were relatively flexible and granted loans prior to the formalisation of a title, which was required for the subsequent regularisation of the bank dossier.

Moreover, in Ghana an additional guarantee is provided by GREL’s purchasing monopoly for rubber. Once the plantation is in the exploitation phase, GREL settles its rubber purchases by crediting the borrower’s bank account, which allows a direct debit to be made for the loan repayment. This system was not possible in the other countries where there are multiple purchasers. As a result, the bank involved in financing smallholder rubber plantations in Ghana is not very selective with respect to the applications presented by the project’s technical team, as shown in Table 21.

Table 21. Percentage of loans refused by the bank

	Cambodia	Vietnam	Ghana
Applications accepted	57	-	99
Withdrawals	39	-	0
Rejections	4	-	1

Source: Cambodia – GRET, 2006; Ghana – GREL, 2008.

In Cambodia, however, the terms for granting loans were stricter since the GRET team conditioned the loan on the current repayment capacities of the borrower, without taking into

account the expected future income from the rubber plantation. A number of candidates withdrew when they heard about this (Table 21). In this case, the project process, which offers a loan tailored to the specific nature of smallholder rubber plantations, is inconsistent with the criteria for selecting borrowers.

3.2.2 Land as an obstacle

It is worth mentioning once again that land issues are crucial to rubber planting in terms of access, security and opportunity costs.

In Ghana, most rubber plantations are established on fallow land that is rotated with subsistence crops (Table 22). The opportunity cost for these plots is relatively low. On the other hand, the actual planting and obtaining of an official land title thanks to the project allow the individual ownership of land to be secured. In this case, rubber planting only seems to present advantages in terms of land development. In addition, long-term leasing systems allow farmers with small amounts of land to access new areas for rubber planting.

In the region of T.T. Hue in Vietnam, municipalities allocate new fallow land, along with a 50-year land title, to farmers who want to plant rubber. The advantage to the farmer is also quite obvious here. The farmer’s main constraint is mobilising adequate labour to establish the plantation and then exploit it. This requirement can generally be met by using contractual labour if there is not sufficient family labour.

Table 22. Type of crops replaced by rubber

	Cambodia	Vietnam (TTHué)	Vietnam (Kontum)	Ghana
Replaces annual crop	about 30 %	5 %	65 %	5 %
Replaces perennial crop	about 70 %	0 %	5 %	11 %
Replaces fallow land	0 %	0 %	0 %	84 %
New land allocated	0 %	80 %	11 %	0 %
Others	0 %	15 %	19 %	0 %

Source: Cambodia - author’s survey; Vietnam – GRET, 2008; Ghana – CIRAD, 2004.

On the contrary, in the case of Cambodia or the highlands in Vietnam (Kontum), planting rubberwood trees means replacing an annual or perennial crop and, consequently, losing the income it generates. For these farmers, it even means accepting to be without income from these plots during part of the unproductive period of rubber cultivation (intercrops are however planted for 1 to 3 years). As a result, most of the planters have other non-agricultural activities to help them cope with this reduction in income. Once the plantation has been established, an official land title is delivered to the farmers, as in the other cases.

3.2.3 Removing the barriers for the beneficiaries

As we have mentioned above, rubber cultivation does have a number of characteristics that pose constraints for many farmers: the cost of planting, length of the immature period, access to specific planting material... The projects were thus designed to remove a number of these barriers.

The loan was, in fact, designed to cover most of the costs of planting and to be repaid only when the plantation entered into the production phase. The projects in Cambodia and Vietnam offered farmers loans to develop their other activities in parallel, and to offset the loss of income due to the immobilisation of a plot during the immature period. In Vietnam, this line of short-term credit was widely used, but by other farmers. In Cambodia, the line of short-term credit was never mobilised. This measure thus proved to be ill adapted.

The projects also conducted research on possible intercrop production during the immature period. Most of the farmers did use the interlines between the rubberwood trees for planting annual crops during the first 2 or 3 years. In Cambodia, farmers were encouraged to plant the rubberwood trees in double interlines in order to leave more room for annual intercrops, which are a source of immediate income. This tech-

nique was not however adopted by the farmers who preferred to maintain the normal density for a rubber plantation (and the future income).

The same reasoning led to techniques being proposed whereby rubber could be combined with other perennial plants such as coffee, coconut palms or oil palms depending on the country. These crops enter into the production phase earlier than rubber and can also reduce risks related to fluctuating rubber prices. Very few farmers actually adopted these techniques, particularly since most of the plantations were created when the price of natural rubber was very high. In Vietnam, farmers combined income from different perennial plants by planting rubber on former plantations (coffee, *bixa orellana*, cashew trees...): when the rubber enters into the production phase the other perennial plant is removed¹⁰.

Surprisingly enough, the projects' technical proposals to allow farmers to combine several sources of income during the immature phase of rubber did not really interest them. It would therefore be necessary to conduct in-depth research on how to better adapt such proposals to the specific constraints of these farmers.

It has already been mentioned that access to land is a major constraint to rubber planting. Conversely, the development of smallholder rubber plantations may possibly have a negative effect on access to land for the poorest. In Cambodia, some consider that the spectacular rise in the price of "red land" (from \$500/ha in 2001 to \$8,000/ha in 2008) is partly due to the rise in the price of rubber¹¹. In Ghana, the long-term leasing of land, particularly for plots easily accessible by rural roads, has become more difficult. This phenomenon can also be clearly seen in Guinea where the development of oil and rubber palm leads to a substantial increase in the cost of access to land.

¹⁰ In Guinea, the SOGUIPAH project proposed support to farmers for the establishment of oil and rubber palm plantations. It was easy for farmers to begin by planting oil palm (a well-known crop that can be processed at village level, with production phase after 4 years) and it was the income from the oil palm that allowed a number of farmers to subsequently invest in a rubber plantation.

¹¹ There is also strong demand for land from urban investors seeking to build up their assets.

Questions of land have been well integrated into projects, but land policy is an issue that requires a specific approach, and AFD has so far had little influence on this matter. All AFD's smallholder rubber plantations projects consequently included

a component for the allocation of land titles. This helped secure land tenure for the farmers, but it did not manage to influence the distribution of land for rubber plantations.

Box 2. Comparison with the SOGUIPAH project, Guinea

SOGUIPAH aimed to allocate 1 ha of oil palms of the Tenera variety, 2 ha of rubber and 0.5 ha of developed lowland to each family included in its plantation programme. SOGUIPAH also aimed to help bring an end to slash-and-burn rice growing, which was accused of deteriorating the environment. To achieve this, palm and rubber plantations were to replace the upland rice without creating a food crisis: the development of the lowlands was proposed to farmers as an alternative that would allow them to continue to produce rice.

Certain conditions required for the farmers to be part of this model plan proved to be decisive and sometimes restrictive. First, they clearly had to have land. Yet the establishment of the first plantations was dependent on the access by rural roads, which in turn froze the possible distribution plan for new plantations. At one stage, to engage in any further planting, a farmer thus had to have the means to buy the best-placed land. Secondly, once the lowlands were developed by

SOGUIPAH, prior development of a lowland plot became a condition for obtaining plantations. It was therefore necessary to belong to the families that were owners of lowlands or to buy a plot. Finally, although not one of the conditions imposed by SOGUIPAH, a sizeable labour force was in reality required—or even a certain amount of capital—in order to begin the programme because the producer was responsible for preparing the land and the plantation himself.

It is for this reason that most of the farmers did not go further than one or two hectares of plantation. The only ones to have sufficient financial resources to buy well-located land, obtain new plantations from SOGUIPA, and finance the works were civil servants, traders, SOGUIPAH executives or Guineans returning from Liberia with savings.

(Extract from Delarue and Cochet, 2008)

3.3 Impacts

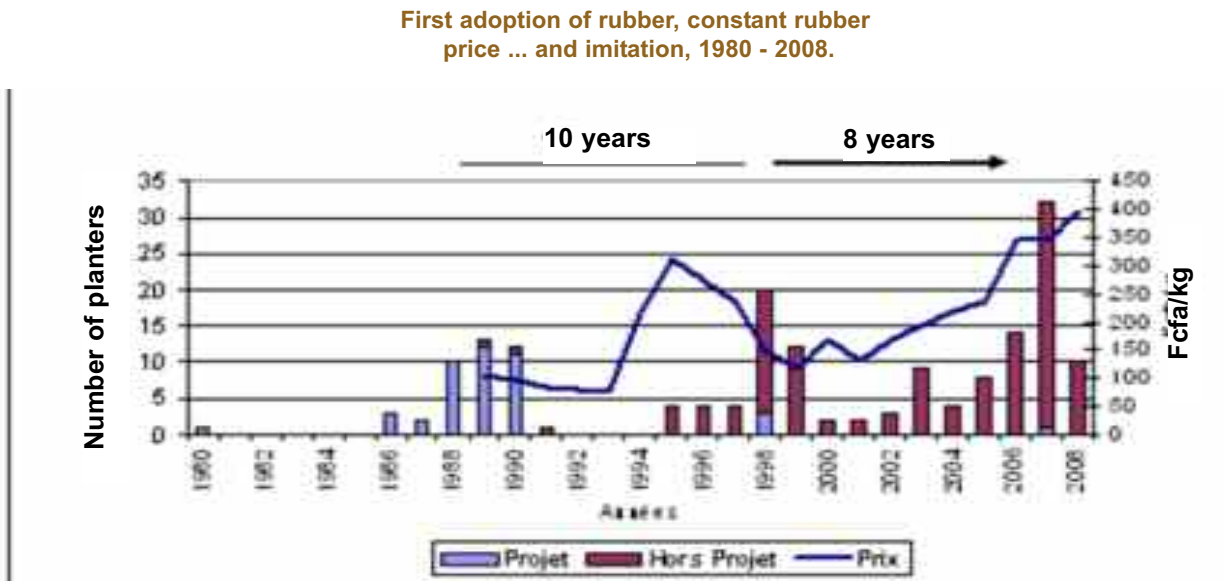
3.3.1 Imitation effect on non-beneficiary farmers

Although access to services provided by the projects was only available to their beneficiaries, part of the “spontaneous” and exponential development of family rubber plantations in these intervention countries may possibly be attributed to the projects.

The situation in the Fromager region in Côte d’Ivoire (Ruf, 2008¹²) where the last smallholder rubber plantations project stopped in 1990 serves as a convincing example. The project withdrawal seemed to herald a decline in village smallholder rubber plantations, no longer benefiting from any support. This

In 1994, under the combined effect of the devaluation and the rise in international prices, the market price of rubber literally jumped up. This has a clear link with the adoption of smallholder rubber plantations by new farmers from 1995 onwards (Graph 3). This would not, however, have happened without the first project plantations. It is above all the situation of the first rubber growers that convinced neighbours of the potential of smallholder rubber plantations. In addition to the income obtained, what persuades farmers to adhere is the fact that the income is monthly (and not annual, as is the case for coffee or cocoa). It is revealing to note that the waves of adoption are separated by 8- to 10-year intervals, which correspond to the time it takes for a plantation production phase to start up.

Figure 3. Adoption of smallholder rubber plantations in the Fromager region, Côte d’Ivoire



Source: number of adopters: surveys Ruf, F., March 2008. Rubber price: SAPH, 2008.

was not in fact the case. On the contrary, two periods of heavy investment in rubber plantations have been observed outside the project, first in 1998-1999, then in an exponential manner since 2006-2007. What factors can explain this?

Moreover, on the Ivorian holdings specialised in cocoa production, the linkage between the two crops is clearly apparent. The areas planted with rubber were larger during the years when the price of cocoa was also high (1995-1999 and 2003) because the farmers had spare income to invest. The ageing of the cacao plantations and the problems involved in renewing them (due to declining soil fertility) also swayed their choice in

¹² Ruf, F. (2008), L'hévéaculture familiale en Côte d'Ivoire : le processus d'innovation dans la région de Gagnoa, CIRAD.

favour of rubber, which is a more resistant crop.

The last phase of investment in smallholder rubber plantations, which is continuing today, also coincides with a sharp fall in the price of cocoa and the generalisation of knowledge about rubber plantations. The Baoule and Burkinabese migrants have themselves begun to grow rubber.

From a technical point of view, continuity has been ensured since the projects ended by the former popularisers, who are still financed by industrial companies under a public-private partnership arrangement. These companies of course have a direct interest in developing village production: establishing one hectare of industrial plantation is extremely expensive, whereas village plantations cost them next to nothing. Moreover, the industrials cannot extend onto new land and are consequently increasingly dependent on village smallholder rubber plantations for their rubber supply. The farmers, however, do not follow the technical itineraries recommended by the popularisers to the letter, and make modifications so as to reduce the investment costs and risks. Besides, there are no longer enough advisors to meet the growing demand for information.

Finally, the author of the study on Côte d'Ivoire estimates that for 1 ha planted within the project, 4.3 ha were planted in this region outside of the project. In addition to the imitation effect and the price factor, public policy has also played an important role by maintaining a network of popularisers for smallholder rubber plantations in the villages.

3.3.2 Impacts at plot level

To estimate the impact of rubber planting on the project beneficiaries, their situation with the project would need to be compared to the situation in which they would have been without the project. The available data do not allow this.

In Cambodia, however, an agrarian diagnosis has established economic results for the crops commonly planted by those types of farmers that have adopted smallholder rubber plantations, which allows us to make a "with-without" comparison at plot level.

Table 23. Economic results of different crop systems in Cambodia

Characteristics	Rubber project	Rubber plants outside project + subsist. crops	Rubber seedlings + subsist. crops	Subsistence Crops	Cashew trees	Banana trees
	H1	H2	H3			
% rubber area	100	60	50	0	0	0
Loan	yes	no	no	no	no	no
NAI av./p.a./ha (\$)	954	830	408	469	485	639
NAI av./fam md (\$)	12.6	7.8	3.5	6.6	10.0	8.6

Note: Rice price: \$0.25/kg; Cashew nut price: \$0.8/kg; Banana price: \$0.17/"hand"

Source: author's surveys and calculations.

Furthermore, we can assume that a number of farmers would have planted rubber even without a project since, although an imitation effect from the project may perhaps be associated with the spontaneous development of plantations, it cannot entirely account for such development. The impact of the project is then a difference in terms of the technical performance of the plantation given a higher investment cost. The comparison between these different types of rubber plantations also makes it possible to assess the impact of the project at the level of a plot.

These are, nonetheless, rough calculations that do not give an accurate assessment of the impact the projects have on production systems, particularly because they do not integrate the changes that rubber cultivation makes to other factors managed by the farmer such as: the allocation of labour, the work calendar, treasury, and their consequences on all the crops on the holding.

In Table 23, the H1 plantations are those of the project. The H2 plantations (respectively H3) were established without a loan: the farmers purchase plants with their own resources (or they plant seedlings). They create a plantation that is 40% smaller (resp. 50%) and use the rest of the area for subsistence crops. The technical itinerary is not completely applied, which leads to lower yields: 70% of the H1 yield in the case of H2 plantations and 25% for H3 (due to poor results from the seedlings).

Table 23 shows that the plantations established without a project and using seedlings, based on the hypotheses outlined below, are less profitable than the cultivation of other local crops (subsistence, cashew nuts, bananas...), at the prices observed in Cambodia in early 2008. However, plantations established without the project, at the farmers' own rhythm, remain more profitable.

4. Sustainability and leverage of AFD's actions to support smallholder rubber plantations

As we have outlined above, AFD's projects to support smallholder rubber plantations began in an unfavourable context of historically low prices. The aim was to show the advantages of smallholder rubber plantations for farmers and to establish technical standards and guarantees that would gradually allow the various actors (banks, national extension services, young plant and input suppliers...) to take over a number of functions.

This context has changed considerably: the number of new rubber growers is increasing at an exponential speed in several countries. It greatly exceeds the number of farmers supported by AFD's projects. The following questions are therefore raised:

- what is the extent of this phenomenon?
- can this development of smallholder rubber plantations be attributed—at least in part—to AFD's projects?
- do these new rubber growers, who are not directly supported by the projects, benefit from the setting up of public or private services supported by the projects?

Providing some answers to these questions can help to assess the sustainability of the results of AFD's projects.

4.1. The exponential development of "spontaneous" plantations

Reliable data on the extension of smallholder rubber plantations in farming areas is not available in most cases due to the lack of rigorous agricultural censuses. However, estimations have been made by public authorities in each of the countries: they stress the extremely rapid spread of this crop among farmers.

In Vietnam, village plantations accounted for 34% of the total rubber area in 2004 compared to 12% in 1995. This increase corresponds to a 519% rise in areas planted by family farmers, whereas industrial sector plantations increased by only 120% over the same period. This represents an annual rise of approximately 20,000 ha between 2000 and 2006. This can be compared with the pace of the project's action, which supported the planting of roughly 6,000 ha a year over the same per-

iod. However, spontaneous plantations also occurred in regions that were not covered by the project.

In Cambodia, the rate of new plantations is estimated at 20,000 ha a year in 2007/2008, of which only 6,000 ha used certified plants. The project itself supported the creation of roughly 425 ha a year.

In Ghana, few spontaneous plantations have been established so far because the purchase of rubber remains linked to GREL and there are few private nurseries. As a result, the spontaneous plantations are most often created by beneficiaries of project support, who expand using their own resources, or by major private investors (such as the Church).

Table 24 highlights the importance of family plantations in each of the countries. The areas financed with AFD support account for a large share of total family plantations: 15% in Cambodia, roughly 20% in Vietnam and 83% in Ghana.

The share of family plantations in the total production of rub-

ber in these countries is lower, as the plantations are still young and production is not yet up and running. The cohabitation of ageing industrial plantations and new plantations leads to relatively low average yields in all the countries (Table 25).

Table 24. Rubber planted areas in the different countries

	Cambodia (2007)	Vietnam (2006)	Ghana (2007)
IP area in tapping phase	23 562		env. 10 500
IP immature area	21 274		env. 3 000
Total IP	44 836	env. 300 000	env. 13 500
FP area in tapping phase	8 824		2 548
FP immature area	16 325		5 952
Total FP	25 149	env. 200 000	8 500
Incl. project FP	3 821	41 040	7 054
Total IP + FP	69 985	512 000	22 000

Note: IP: Industrial plantations; FP: Family plantations .

Source : national statistics, 2007.

Table 25. Rubber production in the different countries

in tonnes	Cambodia (2007)	Vietnam (2006)	Ghana (2007)
Off latex production	30 000	223 901	0
TSR 10/20 production	5 000	109 220	15 000
Others	0	212 979	0
Total	35 000	546 100	15 000
<i>Total processing capacity</i>	<i>160 000</i>	<i>-</i>	<i>env. 20 000</i>
IP production	25 000	-	11 700
FP production	10 000	-	3 300
Total	35 000	546 100	15 000
Total area in tapping phase (ha)	32 386	356 000	13 048
Average yield (t/ha)	1,08	1,53	1,15

Source: national statistics, 2007.

4.2 Can AFD’s projects support the spontaneous development of smallholder rubber plantations?

The projects may have indirectly encouraged the spread of smallholder rubber plantations in village areas, as described above (3.3.1). Insofar as AFD aimed to promote the growth of natural rubber production and export, in each country, it is important to determine to what extent the services developed by the projects are accessible over the long term and to farmers that are not direct beneficiaries of the projects.

4.2.1 Access to and sustainability of services provided by the projects

Diagrams 1, 2 and 4¹³ show how the three programmes have met the needs of the three types of key actors in rubber plantations: the farmers themselves, the banks and the nurseries.

The investment year is, of course, the year where the needs for services are the most diversified. The above diagram shows

the breakdown of tasks in the three projects during this key year.

In Ghana, a number of services are provided by the private company, GREL, and are paid for by the farmers in the framework of the plantation loan. Project-funded GREL teams provide the farmers with technical advice, without the total related cost being passed on to the farmers. The team also has an intermediation function with the bank and the land administration. The Rubber Outgrowers and Agents Association (ROAA) is gradually positioning itself as an interlocutor of GREL and the bank. The presence of these permanent interlocutors means there is a good chance that the actions will be sustainable, possibly without external financing. However, the number of “spontaneous” plantations is limited by the fact that a number of services rely on GREL, particularly for the supply of rubber plants. GREL today is supporting ROAA’s development of its own nursery.

Diagram 1. Project interventions during the investment phase – Year 0

		VIETNAM		CAMBODIA		GHANA	
		Project	Permanent entity	Project	Permanent entity	Project	Permanent entity
The planter needs	Inputs		Traders	*	Traders		GREL
	Certified plants	*	Nurseries	*	Nurseries		GREL
	Technical advice	*	Extension service, relay farmers	*	GDRP	*	GREL
	Credit	*	VBARD	*	RDB	*	NB, ARDB
	Land title	*	Registry	*	Registry	*	Land adm.
the nursery needs	Advice			*			GREL
	Credit			*			
	Graft wood		Nurseries	*	Budwood gardens		
	Certification		RRIV	*			
The bank needs	Credit line	*	MinFin	*		*	MinFin
	Customer selection	*	VBARD field officers	*		*	ROAA, GREL
	Guarantees	*	Planter (land title)	*	Planter (land title)	*	ROAA, GREL, planter (land title)

Source: author.

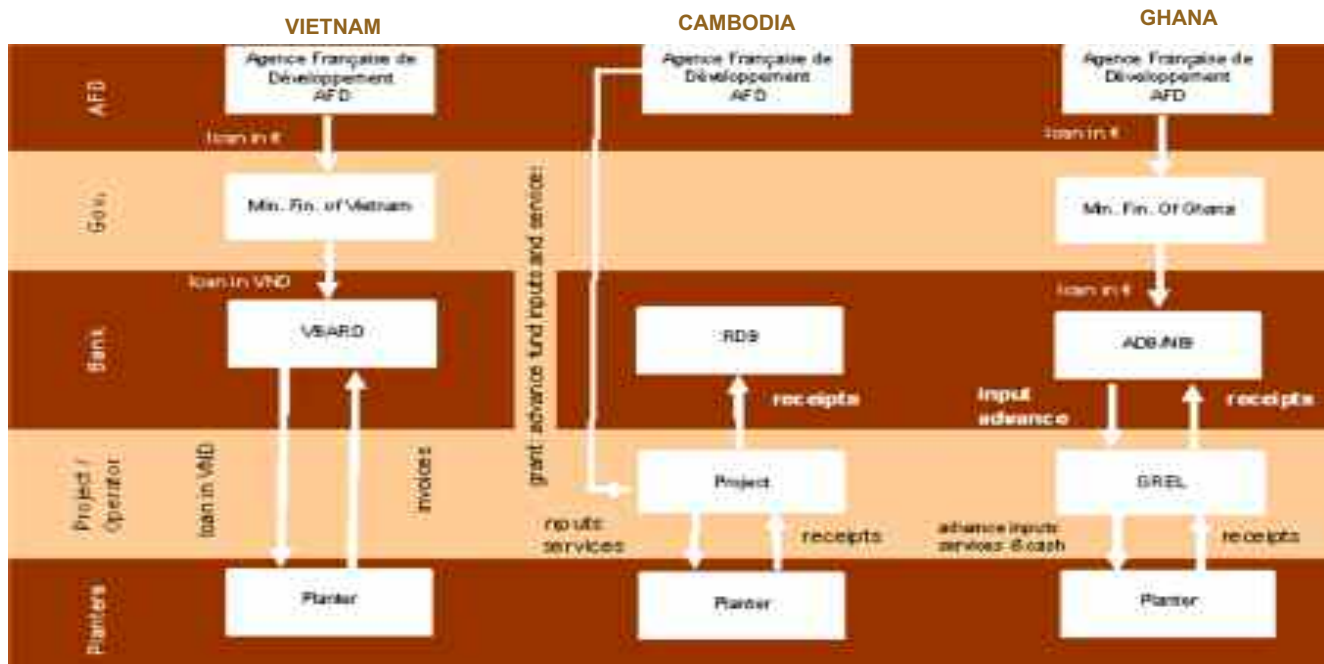
¹³ The brown boxes indicate the areas where the short-term programme entity played a role. The entity sometimes supported the action of the permanent actors shown in the beige boxes. When a permanent actor acted autonomously there is no brown box (showing project intervention) next to the blue box. Conversely, a beige box alone shows that the project intervened without having found any permanent structure on which to base its intervention.

Diagram 2. Project interventions during the maintenance phase – Years 1 to 7

		VIETNAM		CAMBODIA		GHANA	
		Project	Permanent entity	Project	Permanent entity	Project	Permanent entity
The planter needs	Inputs		Traders	x			GREL
	Technical advice	x	Extension service, relay farmers	x	GRP	x	GREL
	Credit	x	VBARD	x	RBD	x	NIB, AFDB
The bank needs	Credit line	x	MinFin	x		x	MinFin

Source: author.

Diagram 3. Disbursement circuit for the project line of credit



Source : author.

In Vietnam, the existence of networks of private traders and nurseries in many cases allowed inputs to be purchased without project support, although the project did set up a guarantee for the young plant suppliers. The quality of rubber plants is, however, not guaranteed under the current system because certification by State services is neither systematic nor transparent. All the other services were provided by permanent entities, with project support. Planters outside the project are not eligible for the specific rubber loans, but some do obtain short-term loans from the VBARD to part finance the cost of planting. The existence of relay farmers in the villages may well be a vector for disseminating technical advice once the project has reached completion, although this is not certain.

In Cambodia, unlike the situation in the other two countries, some functions were provided by the project team alone, as they had found no permanent local entity to relay them. This situation was particularly critical for implementing the credit line. The project support for the creation of a budwood garden and nurseries made it possible to supply good quality young plants although this is, unfortunately, still limited with regard to the exponential growth of “spontaneous” rubber plantations.

This analysis is extended to the years of maintenance for the bank and the planter. A recurrent problem is ensuring coverage of maintenance costs through bank loans: the credit line set

up during the AFD projects only lasts a maximum of 4 or 5 years and is too short to cover the cost of the end of the immature period (particularly the financing of tapping tools in year 8). AFD often required the State to finance the end of the planting as a “specific undertaking”. The disbursement scheme between the Ministry of Finance and the Banks has been set up in Ghana and Vietnam (as shown in Diagram 3), but the States generally turned to AFD to obtain a new project with a new credit line in order to ensure its continuity.

In Cambodia, the financing scheme was totally dependent on the project, which received an advance payment from AFD (Diagram 4). In the current phase—without the project—it is planned for the farmers’ associations and the smallholder rubber plantations office, within the General Directorate of Rubber Plantations, to take over some of the functions of the project, unfortunately with extremely limited resources.

Project support during the exploitation phase generally concerns training in tapping and detecting rubber diseases. The actual yield of a plantation depends on the skills of the tapper and the phytosanitary surveillance of the plantation. Due to the limited life span of the projects, this support will probably not be provided to a majority of planters in Cambodia and Vietnam. In Ghana, GREL will take care of this, as it is in its interest to guarantee the quality of its rubber supplies.

Diagram 4. Project interventions during the exploitation phase – Years 8 to 40

		VIETNAM		CAMBODIA		GHANA	
		Project	Permanent entity	Project	Permanent entity	Project	Permanent entity
The planter needs	Technical advice		Relay farmers		GDRP		GREL
	Marketing advice				FOs?		ROAA

Source: author.

From a marketing point of view, it was necessary to train the planters, particularly in how to calculate the dry rubber equivalent (DRE) rate for the fresh product and negotiate a fair price. In Ghana, the price negotiations were generally between GREL and the planters' association, but the way in which the DRE is calculated is not completely transparent. In Cambodia, the farmers' organisation set up by the project could handle this aspect if it is given the resources to do so. In Vietnam the issue has not been addressed.

In conclusion, it would appear that for a number of functions, the duration of the projects is a constraining factor insofar as support for farmers is not ensured from the planting phase up to the exploitation phase on the rubber plot. In addition, the extension of these services outside the project is jeopardised by the low capacity of some permanent actors to take charge of these functions themselves, and is quite unrealistic without government support. The following extract from the final report on the Cambodia project illustrates these difficulties.

Box 3. Extract from the final report on Smallholder Rubber Plantations in Cambodia

The dismantlement of the local scheme after project completion cuts off the financial administration and technical administration from the population concerned. Although it may still be possible to supervise the existing plantations through professional organisations, there is no possibility of creating new planting campaigns financed by loans.

It must be remembered that a category called "no loan" planters appeared during the 2006 harvest, i.e. once the corresponding nurseries were created in July 2005. This opportunity, which clearly emerged with the rise in the market price for rubber and made smallholder rubber plantations financially very attractive, was not taken up by the administration as a chance to develop quality smallholder rubber plantations on a large scale. And yet, the appearance of these "no loan" planters at the end of the project nonetheless offered a fine opportunity to promote a sector that is potentially profitable

not only for the individuals concerned, but also for the national economy as a whole, since the economy could have benefited from a sound basis for development by furthering the emergence of a well-off agricultural population with a self-financing capacity that is essential for the successful diversification of export crops.

In conclusion, the project was not able—for either the population in need of loans to create plantations or for farmers with substantial financing capacities—to transmit and establish in the longer term the essential notion of close involvement of the local administration in managing the agricultural sector. Proposals to bring the project closer to the provincial representations of the agricultural departments were never approved by the central administration for plantations, which was concerned about keeping its prerogatives.

We feel that some actors have not been sufficiently supported or made aware of their responsibilities in terms of taking over permanent functions when projects have reached completion.

It would thus have been necessary to support the emergence of rubber planters' organisations more systematically and from a very early stage. Ghana provides a good example of an effective support method (an NGO independent from the

project) and the role that FOs can play. In Cambodia, the development of FOs was supported at a late stage but does look promising. In Vietnam such an entity has not yet been envisaged.

In these intervention countries, AFD lacked the weight required to make the role of the State gradually evolve towards these permanent functions (cf. Section 4.2.3).

4.2.2 Allocation credit

The difficulty of making the service offer for smallholder rubber plantations sustainable can be seen more specifically in the implementation of the credit line. It was core to AFD's intervention in all three countries. One of the main difficulties concerned the choice of a bank that was reliable and well-established in rural areas to distribute loans to planters, but there was also the issue of defining a long-term product that could be replicated in local conditions.

Participating financial institutions

In Ghana and Vietnam, the credit line was first entrusted to the National Banks for Rural Development that had networks in rural areas. However, management problems were observed in these two banks. It was subsequently envisaged to organise a bid invitation to allow other banks or microfinance institutions to benefit from and manage the rubber credit line. This bid invitation worked in Ghana where a private bank seized the opportunity to develop in rural areas. In Vietnam, the bid invitation will take place within the framework of the project which is currently being appraised.

Cambodia is a specific case because the management of the credit line was entrusted to the RDB, which was at the time a "wholesale" bank in charge of refinancing commercial banks. Since none of these commercial banks were established in rural areas, AFD entrusted the management of the credit line to a project team, with technical assistance from GRET. It was planned to have the credit line taken over by a microfinance institution at a later stage. However, the type of credit implemented in the framework of the project for rubber planters is not sustainable for microfinance institutions with respect to both interest rates and maturity of the loans. This meant that the RDB finally took over the project team and the finance to ensure the recovery of the rubber loans. No new rubber credit will be allocated from now on, although grant resources are still with the RDB. There remains the question of how these will be used.

Bank ownership of the product

In Vietnam, as most of the planters were already clients of the VBARD, project intermediation focused mainly on the technical aspects of the plantation. This analysis can, in fact, be partly conducted by VBARD officers who have been trained by the project. The loan disbursement circuit is also reproducible by the VBARD without a project, as can be seen in Diagram 4. However, this product is unattractive and difficult to reproduce by the bank for two reasons. First, the bank does not have the long-term resources to reproduce it and, second, the salaries of the loan officers partly depend on loan repayments which means that rubber loans with a long grace period offer little incentive. When banks independently implement these loans, they also unilaterally reduce the grace period. In Vietnam, the bank did to some extent take on ownership of the rubber loans, but not under the terms proposed by the project.

In Ghana, the system for granting loans is only replicable in the framework of a tripartite agreement between the farmer, GREL and the NIB. The NIB is taking advantage of the project to create a new client base, to which it now offers short-term loans alongside the rubber loan. These short-term loans are guaranteed by income from plantations and the rate of additional indebtedness can reach 50% of the net outstanding amount after repayment of the rubber loan. However, for the time being the bank no longer grants long-term loans due to a lack of resources.

In Cambodia, as it has been mentioned above, the loan terms for rubber growers were not appropriate for financial institutions present in rural areas.

In conclusion, the application of rates in line with market rates and the use of existing networks are factors for sustainability. However, the banks are dependent on the long-term credit line set up within the framework of the project in order to be able to operate. They consequently confine the rubber loans to the beneficiaries selected by the project.

Loan recovery

The repayment cost is generally limited to 25% of the theoretical net income of the farmer during the exploitation years.

In Vietnam, the VBARD is well established in rural areas and conducts operations for rubber loan recovery as it does with all the other types of loan. There are, however, problems of unpaid loans on rehabilitations, which amount to between 10 and 15%. This may be due to the low yields obtained on this type of plantation.

In Ghana, GREL pays the amounts for the purchase of rubber into the planter's account at the bank, which immediately withdraws the repayment. This system may be inadequate if competition emerges for the purchase of rubber. This is what happened in Côte d'Ivoire where the SAPH finally stopped withdrawing loan repayments from the payments to planters in order for the latter to resume their deliveries. It would also appear that the repayment schedules were no longer kept by the Bank and the situation of each planter had not been well established.

In Cambodia, the project team, now paid by the RDB, is in charge of loan recovery. The end allocation of the amounts recovered is currently being discussed with the Cambodian government. If the discussions do not soon come to fruition, the history of this credit line may be lost with the likely risk of it being reallocated for other purposes by the RDB.

What future proposals?

On the one hand, the rubber loan as defined in the projects is a product that is difficult for banking institutions to replicate. On the other hand, it is expensive for the planters, as the cost of planting is doubled due to the interest rates charged and the repayment period.

The unit cost for a loan could be reduced in different ways. First, by not financing family labour with the loan, and then, by disseminating less costly technical itineraries, even if this does mean yields will be lower. Finally, it could be envisaged that partner States be asked—within the framework of a policy favour-

able to smallholder rubber plantations—to partly or entirely finance young plants (if this were partnered by a private firm, the cost could be borne by the operator that benefits from the increase in production). This subsidy could, where required, be earmarked for the poorest families.

Additionally, it appears that with the spontaneous development of rubber plantations not all planters necessarily require credit. During the appraisal of the National Plan for Family Rubber Plantation (NPFRP) in Cambodia, it was planned to reserve the credit for the poorest families that could not finance the rubber plantation themselves. The product proposed by the feasibility study could more easily be taken on board by a microfinance institution and costs less for the planter: 19% annual interest rate, interest repayment over 5 years without a grace period and repayment of the principal over 3 years (i.e. an 8-year loan in total). This arrangement would hold during periods of high prices, but would need to be adapted should prices fall with repayment of the principal then being rescheduled. It is also envisageable to cease using long-term loans to finance tapping equipment, and instead grant short-term loans at the end of the immature period.

4.2.3 Designing a policy favourable to smallholder rubber plantations

We have already stressed several times that these projects are intended as pilot approaches that would ultimately enable the partner State to adopt a policy adapted to the development of smallholder rubber plantations. Thailand has become the world's biggest exporter of natural rubber and is setting the example for a successful policy to promote smallholder rubber plantations (Box 4).

In Cambodia and Ghana, the smallholder rubber plantation projects were clearly designed to be pilot phases that could test and prepare for the implementation of more ambitious national programmes. In both these countries, AFD contributed to financing studies that would serve as a base for the definition of a national policy to support smallholder rubber plantations.

In Ghana, the study conducted in 2005 was adopted as such by the Ministry of Agriculture as its rubber master plan. The role of the State within the plan, however, is extremely limited and GREL has to manage most of the functions. This approach thus places strong limits on the potential for the spontaneous development of smallholder rubber plantations as it creates de facto a quasi-monopoly for this company.

In Cambodia, the study conducted in 2007 notably recommended various options in terms of taxation and the allocation of land to family rubber planters. The Cambodian government has for the time being refused to act on this.

In Vietnam, the State establishes its own development plan for smallholder rubber plantations and seeks the financing to implement it.

AFD does not have sufficient weight to influence the development of policies involving such sensitive issues as land or taxation. AFD sought to mobilise cofinancing, notably from the Asian Development Bank and World Bank, but finally did not manage to do so. In Ghana, cofinancing with Kreditanstalt für Wiederaufbau (KfW) means that an extension of the project to other industries can be envisaged, but this does not necessarily mean influencing political decision-making.

Box 4. Thailand's rubber policy

The State can play many roles in effectively developing smallholder rubber plantations at the national scale, as can be seen with the example of Thailand.

Thailand is today the world's biggest producer and exporter of natural rubber. The bulk of its production comes from family plantations and processing is generally handled by farmers' cooperatives. The Thai State has taken decisive political options to achieve this result:

A subsidy for planting or replanting is allocated by the ORRAF (Office of Rubber Replanting Aid Fund) to cover the entire cost of young plants and fertilizer. This subsidy amounts to roughly \$2,000/ha for a maximum of 4.8 ha (30 rai) for the new plantations and there is no limit on replanted areas.

ORRAFF is also in charge of providing technical advice to planters from planting to exploitation and marketing.

The national research centres and the departments of the Ministry of Agriculture are in charge of the certification of private nurseries. This guarantees the quality of the planting material that is used.

The bank for agriculture allocates additional loans to rubber planters with 15-year maturities, a 7-year grace period and a rate ranging between 7.5 and 10.5% p.a.

Since 1975, the ALRO (Agricultural Land Reform Office) has been distributing land from the public domain to farmers that have land area of under 8 ha. Most of the cultivable public land has, however, already been distributed and the ALRO simply checks that it is actually being used.

The Thai State finances these different measures via a tax on natural rubber exports (2% of the FOB price).

5. Lessons learned

5.1 Strengths and limits of the model

5.1.1 An effective model to support family farming

The three projects studied developed a model for the technical implementation of smallholder rubber plantations giving yields that are as good as—or even better than—those of industrial plantations. The costs are high and unaffordable for most family farmers and need to be covered by long-term credit, which has meant that a large share of the financing being used to replenish a credit line.

As they stand, the projects have consequently provided, or will provide, family farmers with substantial income thanks to “professionally implemented” rubber planting. In addition, it seems that once the first plantations are in the production phase most farmers continue to invest in rubber plantations with their own funds... or at least for as long as the price of natural rubber remains high. The number of these farmers concerned by AFD projects exceeds the initial targets and is by no means insignificant: over 1,000 in Cambodia, over 2,000 in Ghana and over 27,000 in Vietnam¹⁴.

Studies show that few rich farmers and few poor people were reached by these projects. As the projects advanced, the type of farmer reached changed from rather well-off innovative farmers to less well-off farmers for whom a rubber loan was indispensable to the establishment of a plantation.

5.1.2 A model partly with targeted objectives

Although the model developed obtained concrete results, it only partly met the three objectives formally attributed to the projects.

AFD’s contribution to the increase in production and export of

natural rubber from smallholder rubber plantations is minimal if only the direct beneficiaries of the project are taken into account. The technical-financial model applied by the project does not seem to be replicable if specific financing is discontinued, which means it will only ever concern a limited number of farmers.

However, by investing in the design of new public policies (in Cambodia) and in the emergence of new permanent actors (farmers’ organisations and nurseries), AFD has sought to give its financing greater leverage with respect to the development of smallholder rubber plantations. AFD has gained legitimacy thanks to its interventions and should pursue its efforts to ensure policies are adopted that allow as many farmers as possible to benefit from the experience gained from its projects.

The projects’ aim of combatting poverty proved to be particularly difficult to reach due to the many constraints that obstruct the least well-off from taking up this crop—as has been widely explained in this report. However, the project monitoring systems did not really seek to define precisely who the real beneficiaries were, and no specific support measures for the different categories of farmers have been implemented for the moment. It would undoubtedly be possible for poor farmers to benefit from growing this crop, which does create wealth, but this would require specific intervention methods. The instruments that would need to be implemented in order to specifically target the poor segments of the population are presented in section 5.3.

¹⁴ We should bear in mind that, in Vietnam, AFD was in cofinancing with the World Bank, and in Ghana with KFW.

Finally, the third objective, set only for the projects in Ghana and Vietnam, was to reforest degraded areas and store carbon. Establishing rubber plantations does not automatically fulfil this purpose because, in a context of higher rubber prices, rubber is planted on plots previously used for other crops, particularly subsistence crops. In Ghana, even though expertise was mobilised on this subject, financing for the rubber plantations could not be obtained from the Carbon Fund because there was no proof of their impact in this context. In Vietnam, no monitoring system is in place that would allow us to determine whether or not this objective has been reached.

It would seem that, although the objectives announced in the official project documents have not really been followed through by specific measures, the underlying objective of proposing a reliable technical model for smallholder family rubber plantations has been achieved.

5.1.3 The paramount importance of the credit line

The credit line proved to be necessary to support the technical offer of the projects, which aimed to promote the most productive plantations possible. This credit line accounted for between 30 and 60% of AFD financing depending on the phases of the project (the proportion was lower at project start-up because support costs were preponderant).

It was difficult to gain the confidence of financial institutions as they require multiple guarantees before granting a rubber loan (in Cambodia: quality of the plantation; land collateral, creditworthiness of the borrower; in Ghana: direct debit of repayments) and for many of them loan approval depends on the intermediation of the project. As a result, the replicability of this credit product outside the project is not feasible.

In addition, the long-term credit line already implemented is not earmarked in the long run for financing smallholder rubber plantations, as these institutions will one day have to pay it back to the Ministries of Finance in their countries. The lack of other sources of long-term refinancing for these banks means that they can only continue to lend to rubber planters if this credit line is renewed by a donor (via a sovereign or non-sovereign loan, as envisaged in Ghana) or by the State. The decision to

keep this resource available to them for financing smallholder rubber plantations is a political one that could be made in view of the benefits that development of smallholder rubber plantations brings to a country.

The spontaneous plantations in Vietnam, Cambodia and Côte d'Ivoire demonstrate that, even without credit, farmers manage to plant rubber as they reduce their planting costs, plant at a slower pace and over smaller areas, but they do nevertheless plant.

Yet, between these two extremes (specific long-term credit that is, however, difficult to reproduce and no credit), it is conceivable that greater sustainability for the financial package can be ensured and that its benefits can be extended to a greater number of planters. This would imply a number of changes.

One possible change would involve reducing the amounts borrowed by the farmers by designing less costly technical itineraries, even if this means not targeting maximum yields. The projects' objectives would thus be to develop an optimal economic model rather than an optimal technical model. This is exactly what the Cambodian and Vietnamese farmers do. They borrow less than planned for their plantations, but they do not have suitable technical advice that would allow them to decide which savings would have the least impacts on yields. A larger proportion of farmers could consequently finance their plantation themselves or take out a short- or medium-term loan, which are the more conventional products provided by banks or microfinance institutions.

A second possible change would be to offer a simplified land guarantee given that land titles were extremely difficult to obtain even with the project's intermediation. Yet banks unanimously state that it would be difficult for them to liquidate this collateral were the planter to default on a loan. In addition, credit was released on the basis of letters from local authorities testifying to the absence of land conflicts pending the permanent title. The latter certainly does constitute an added advantage for rubber project beneficiaries, but could perhaps cease to be an essential component in setting up loans for smallholder rubber plantations.

From the point of view of replicating the loan scheme tested during the projects, the case of Cambodia makes it clear that negotiation with the financial institutions needs to take place prior to the project and that the project can in no case manage the credit function. If no loan operator is able to provide this service, in whatever form, it would then be advisable to intervene mainly through technical advice, which would of course

be of benefit to those able to finance themselves. It would also be advisable to operate through grants or short-term credit to cover certain expense items in order to support the poorer categories of the population.

5.2 Short-term interventions in a long-term cycle

5.2.1 Managing a lengthy cycle

The length of the rubber development cycle creates a series of practical difficulties that the projects attempted to remedy. Project intervention has the drawback of being based on a period of time that is too short compared to the overall cycle.

As a result, the financing of plantation maintenance, once the immature period terminates, is generally problematic. In theory, maintenance should be financed by the credit line, but this is only gradually disbursed by AFD to the bank issuing the credit and not as a lump sum to cover all expenditures. This means that the project reaches completion without the bank having resources to finance this mature period. Consequently, AFD usually concludes an agreement with the project owner whereby the latter undertakes to cover the cost of financing further amounts, but this type of agreement for the post-project period is inherently fragile.

Another example is that the training in tapping techniques also takes place between 6 and 7 years after the establishment of the plantation and therefore generally after project completion. Yet learning these techniques is absolutely essential to ensure the plots are productive.

In practice, it is above all the sequencing of several project phases that can resolve these problems of duration and the fact that AFD managed to ensure this is positive for the beneficiaries.

However, changes could be envisaged with a view to sustainability and extending the benefits of AFD interventions to a greater number of planters.

Concerning the maintenance at the end of the immature period and the continuation of investments, one solution could be to permanently transfer the credit line to a bank in exchange for an agreement on the allocation of the resources to smallholder rubber plantations, which would be monitored by a regular audit. In addition, the bank could also undertake to use short-term resources to temporarily offset the shortfall in treasury.

Concerning the training in tapping, it is vital that this be provided by permanent entities, with financing guaranteed over the long-term, possibly with State resources, since all the planters need training whether or not they are project beneficiaries. In Côte d'Ivoire or Guinea, in addition to the project-delivered training, skills can be transferred by employing tappers that have prior work experience in industrial companies. In Ghana, GREL will probably continue to provide this service, which is also in its own interest. However, in Vietnam and Cambodia, farmers' entities should perhaps be targeted: relay farmers mobilised for ADP1 in Vietnam and planters' organisations in Cambodia.

5.2.2 Reliance on permanent actors and contractual arrangements

The above descriptions of the credit and training aspects could in fact be extended to all the services provided to planters. The comparison of the three contexts has been particularly revealing in this respect, since it clearly appears that AFD attempted to provide the same services to farmers via its projects, whether or not permanent entities capable of providing these services already existed or not.

Of course, AFD's projects can, to a certain extent, contribute to the creation of institutions or organisations that would be capable of sustainably assuming a role initiated by the projects. However, for AFD this implies a long-term commitment mostly via grants. In this respect, support for the creation or development of planters' organisations in Cambodia and Ghana is a legitimate and ambitious long-term investment to which AFD should remain committed. In these two countries, the planters help to finance a fund that will ensure the sustainability of some services provided by the FOs.

However, certain institutional gaps proved to be impossible to remedy: the absence of an entity to finance agriculture in Cambodia could not be bridged by the voluntarist intervention of the project.

But even if permanent entities exist, it is also the way in which they are mobilised that dictates whether or not they will be sustainable. The existence of a tripartite contract between GREL, the bank and the planter in Ghana is a model that can be reproduced outside the project. However, contracts signed between the project entity and a permanent entity do not extend beyond the project duration.

5.2.3 Integrating into policy frameworks

AFD earmarks substantial resources in some of its projects to support the gradual construction of policies that develop and strengthen project benefits. In Ghana, the recruitment of a

technical assistant financed by a project grant should help the Ministry of Agriculture formulate its policy for the development of perennial crops. In Cambodia, a national plan for smallholder rubber plantations has been designed, but has not yet been adopted by the government. In Vietnam, the scale of the project and its piloting by the administration have given it an almost "political" dimension in 11 provinces.

In addition to the credit issues mentioned above, the main topics addressed in this thinking on policies favourable to smallholder rubber plantations concern:

- the long-term financing of certain services, such as advisory services or the certification of planting material and, more specifically, with their cost being borne by the State budget;
- the targeting of specific support to certain categories of population (the poor, minorities...);
- the management and securing of land resources.

This long-term process is extremely relevant. AFD has acquired some legitimacy to participate in the political dialogue thanks to the positive results achieved by its projects and must pursue its efforts to support institutional construction. However, without support from other donors it is difficult for AFD to influence the political agenda. It must continue to invest in this area, while accepting the time lag between this agenda and its own projects. The role of the project officers in the agencies is essential in this respect.

The Thai model is a reference, particularly with respect to its creation of a tax system specific to the rubber industry, which allows it to finance permanent services, target the poor and promote access to land. This model is, however, linked to the paramount importance that the Thai State has given to smallholder rubber plantations in national development. It can only be proposed in our other intervention countries insofar as they give this sector the same importance.

5.3 What interventions with what objectives?

Pursuing an objective of developing natural rubber exports and economic growth implies promoting the establishment of best possible quality rubber plantations for a large number of farmers. The spontaneous expansion of rubber plantations in 2007-2008 proves that when prices are high many farmers want to, and can, plant rubber using their own means. To maximise the production potential that this represents, it is important to provide the farmers who are the most financially autonomous with access to high quality planting material and relevant technical advice, without necessarily seeking optimal technicality. To achieve this, AFD must seek to support the definition and implementation of a policy that provides for:

- the implementation of a national system for the certification of planting material;
- the implementation of a national system to advise planters and nurseries;
- the implementation of specific financing mechanisms to cover the costs of certification and advice.

Pursuing a priority objective of developing highly productive smallholder rubber plantations by family farmers, as has been the case with the projects to date, also requires access to credit.

The contractual scheme developed in Ghana is highly attractive for the purpose of involving banks in project preparation. In Vietnam and Cambodia, this scheme could also be envisaged for the development of smallholder rubber plantations on a regional or provincial scale in partnership with one or more companies wishing to develop their supply of rubber. This scale is also the most easily managed by AFD projects. The technical model for planting developed in the previous phases of the projects could be replicated by technicians in these companies, initially financed by the State, then at least partly by the company¹⁵ and a tax on village production. It would then be essential, as in Ghana, to require a clear and transparent

contract be signed between the company, the bank and the farmer—and even with certain collecting intermediaries—to ensure the interests of all are respected. The partner States and AFD should bring their influence to bear more specifically on ensuring the drawing up of contracts that are equitable for all, and should finance the emergence and strengthening of an autonomous planters' organisation as an effective counterbalance to the company. After an initial phase of financing via a sovereign loan, a non-sovereign loan to the bank could be envisaged, as is currently the case in Ghana.

One alternative that is consistent with the first two objectives, and which would help to finance a larger number of plantations, would be to support the design of short- or medium-term products that would only cover some of the rubber growers' needs. This would be easy to adopt or reproduce for financial institutions already established in rural areas.

Finally, pursuing an objective of combating poverty through smallholder rubber plantation projects first requires that States be encouraged to take political measures in favour of the poorest. These decisions go beyond the framework of village smallholder rubber plantations but can, however, be backed by further thinking on this industry, if the latter is particularly strategic for the State. This could initially involve targeting the distribution of land for the poorest, which is theoretically possible in Vietnam and Cambodia, or at least in certain regions where there is land to be attributed and where the poor are systematically recorded by the local authorities. In Ghana, landlords now lease land for rubber plantations to farmers with less land in exchange for a share of the profits: in this context, where the State records and secures the transaction, the profit-sharing method could be regulated by the authorities if it were excessively disadvantageous to the farmer.

In this configuration, land policy measures in favour of the poor should be backed by targeted measures to subsidise the

¹⁵ GREL today prefinances the extension of some farmers' plantations out of its own resources.

cost of planting. This national policy could—if the fiscal resources available allowed it, as in Thailand—provide for a 100% subsidy of a maximum of 4 ha of rubber plants for all farmers: this would ensure the quality of the plantations established and enable the poorest farmers to invest in this crop.

The technical support to these farmers for planting can be provided in the framework of either state-funded services or a contractual relationship with a company, as in the two cases mentioned above.

Conclusion

In conclusion, AFD appears—with its partner administrations—to be in a position to learn lessons from the experience shared in this promising economic sector in order to adapt and integrate the smallholder rubber plantation model, which has proved successful in terms of performance, into policies ensuring its sustainability and up-scaling. Depending on the context, these policies will have a greater or lesser role in terms of combating poverty. They will also adapt support and

financing mechanisms—and thus the instruments used by AFD—in line with the relevant target. The level of commitment of the partner States to support smallholder rubber plantations, together with the support AFD receives from other development partners in this sector, will be decisive in enabling AFD to make headway on the path to building a new generation of projects and programmes.

APPENDICES

Appendix 1	Physical norms to establish and farm a rubber plot
Appendix 2	Loan repayment schedule in Cambodia
Appendix 3	Loan repayment schedule in Vietnam
Appendix 4	Economic calculation scenario with project (H1)
Appendix 5	Economic calculation scenario without project (H2)
Appendix 6	Economic calculation scenario without project (H3)

Appendix 1. Physical norms to establish and farm a rubber plot

Table 1. Physical norms to create 1 ha of plantation (Y0 to Y7) with tilling (intercrops)

Year	unit	Y0 1	Y1 2	Y2 3	Y3 4	Y4 5	Y5 Y7 6 to 8
Preparation of land							
Clearing Burning	md	20					
Tilling	unit	0					
Compost transport	unit	1					
Stake planting	md	5					
Hole digging	md	20					
Subsoil manure spreading	md	10					
Planting	md	12					
Total							
Young plants							
Stump sack	unit	555					
Replacement sack (20%)	unit	111					
Total							
Inputs							
Subsoil P manure	kg	277.5					
Compost	kg	5550					
Bamboo protector	unit	555					
Termite insecticide	tower	1					
Sprayer	unit	1		1			
Foliar fertilizer	litre	4	4				
Urea	kg	50	120	225	225	150	150
P	kg	150	360	675	675	450	450
KCl	kg	15	30	60	60	40	40
Fungicide	tower	4	4				
Glyphosate	litre	3	3	3	1	1	1
Total							
Labour							
Replacement	md	3					
Fence	md	6					
Basin	md	10	10				
Mulch	md	20	10				
Foliar manure	md	11	6				
Seedling care	md	10	8	6	4	2	1
Manure	md	10	10	10	10	10	10
Line maintenance	md	20	20	15	10	8	5
Interline maintenance	md	10	10	10	10	8	5
Total		100	74	41	34	28	11

Source: feasibility ADP2. Vietnam – SOFRECO, 2007.

Table 2. Physical norms to establish 1 ha of plantation (Y0 to Y7) without tilling

Year	unit	Y0 1	Y1 2	Y2 3	Y3 4	Y4 5	Y5 Y7 6 to 8
Preparation of land							
Clearing Burning	md	20					
Tilling	unit	0					
Compost transport	unit	1					
Stake planting	md	5					
Hole digging	md	20					
Subsoil manure spreading	md	10					
Planting	md	12					
Total							
Young plants							
Stump sack	unit	574					
Replacement sack (20%)	unit	114					
Total							
Inputs							
Subsoil P manure	kg	277.5					
Compost transport	kg	2710					
Bamboo protector	unit	671					
Termite insecticide	tower	1					
Sprayer	unit	1		1			
Foliar fertilizer	litre	4	4				
Urea	kg	50	120	225	225	150	150
P	kg	150	360	675	675	450	450
KCl	kg	15	30	60	60	40	40
Fungicide	tower	4	4				
Glyphosate	litre	3	3	3	1	1	1
Total							
Labour							
Fence	md	3					
Fence	md	6					
Basin	md	10	10				
Mulch	md	20	10				
Foliar manure	md	11	6				
Seeding care	md	10	8	6	4	2	1
Manure	md	10	10	10	10	10	10
Line maintenance	md	10	20	15	10	8	5
Interline maintenance	md				10	8	5
Total		80	64	31	34	28	21

Source: feasibility ADP2. Vietnam – SOFRECO. 2007.

Table 3. Physical norms to farm 1 ha of plantation (Y8 and after)

Year	unit	Y8	Y9+
		9	10•
Inputs			
Urea	kg	50	50
P	kg	50	50
KCl	kg	50	50
Fungicide	1	2	4
Tree equipment	unit	200	200
Tapping equipment	unit	1	1
Total			
Other labour			
Manure	md	4	4
Maintenance	md	10	10
Preparation tapping	md	8	1
Tapping equipment	md	60	120
Tree Care	md	4	8
Total		86	143

Source: feasibility ADP2. Vietnam – SOFRECO. 2007.

Appendix 2. Loan repayment schedule in Cambodia

CAMBODIA																								
Table 25: p.s. and prepayment																								
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL			
Amount of loan received (\$)	250	71	65	63	69	48	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on capital of the year	22,5	6,4	5,0	5,7	6,2	4,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on amount of prev. year		30,6	40,3	49,2	59,9	72,1	83,4	50,5	23,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Accrued capital	317,0	388,0	443,6	506,0	576,0	624,0	628,2	0,0	0,0														557,0	
Accrued interest	22,5	63,4	114,7	159,3	225,7	302,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	537,5	
Repayment					360,5	468,0	261,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1 089,5
Total					649,5	240,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Fixed price (\$)					0,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Fields (ha)					800	3000	1300	1500	1000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
SWA					1440	8000	2340	2700	3240	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
Amount to repay					360,5	468,0	261,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Loan					0,20	0,20	0,10	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05

CAMBODIA																								
Table 26: p.s. and prepayment over 10 years																								
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL			
Amount of loan received (\$)	250	71	65	63	69	48	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on capital of the year	17,5	5,0	3,9	4,4	4,8	2,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on amount of prev. year		23,4	30,4	36,3	43,9	52,1	59,2	65,7	45,9	40,1	35,1	29,1	22,9	16,0	6,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Accrued capital	317,0	389,0	442,0	506,0	576,0	624,0	649,2	0,0	0,0														957,0	
Accrued interest	17,5	45,9	80,1	121,1	169,9	225,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	856,9	
Repayment					120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	1 213,0
Total					788,9	724,1	654,8	580,8	501,3	410,4	325,5	228,3	124,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Fixed price (\$)					1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Fields (ha)					300	1000	1300	1500	1800	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
SWA					1440	1000	2940	2700	3240	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	
Amount to repay					120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	120,0	1 213,0	
Loan					0,02	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	

CAMBODIA																								
Table 27: p.s. and prepayment over 10 years																								
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL			
Amount of loan received (\$)	250	71	65	63	69	48	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on capital of the year	22,5	6,4	5,0	5,7	6,2	4,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Interest on amount of prev. year		30,6	40,3	49,2	59,9	72,1	83,4	50,5	23,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		
Accrued capital	317,0	388,0	443,6	506,0	576,0	624,0	628,2	0,0	0,0														557,0	
Accrued interest	22,5	63,4	114,7	159,3	225,7	302,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	833,8	
Repayment					864,5	892,9	730,2	650,9	564,5	470,3	367,6	256,7	133,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1 450,8
Total					0,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Fixed price (\$)					0,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
Fields (ha)					800	3000	1300	1500	1000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
SWA					1440	8000	2340	2700	3240	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	
Amount to repay					145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	145,0	1 450,8	
Loan					0,03	0,06	0,05	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	

Source: author's calculations.

Appendix 4.

Economic calculation scenario with project (H1)

Assumptions with project

- Area 4 ha - "max" investment
- Intercrops = 2/3 of area for 3 years
- Loan in riels - Prepayment in 3 years
- Rubber growing project: yield: 2t p.y.
- Start of tapping phase: 6th year

General assumptions

- 1 worker = 300MD
- 1 MD ext labour: USD 1.25
- Intercrops: soya/sesame/corn
- Price: 1.8 \$/kg

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
International rubber price c.\$/kg	79.28	102.7	123.8	140.1	202.3	216.7	249.4	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Price paid to producer c.\$/kg	43.6	69.36	71.37	81.48	111.8	118.7	137.2	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Blauddica exte. projct.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Area in ha	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rubber	0.0	0.0	0.0	0.0	0.0	380.0	500.0	1250.0	1800.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0
Yield (t/ha)	0.0	0.0	0.0	0.0	0.0	1706.7	4537.7	3142.0	610.0	500.0	544.0	544.0	544.0	544.0	544.0	544.0	544.0	544.0	544.0	544.0	544.0
Revenue (t)	0.0	0.0	0.0	0.0	0.0	649.1	2099.0	3900.0	1020.0	858.0	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6	2959.6
Investment and fert(fuel value) (t)	1194.8	377.8	307.5	256.4	248.1	259.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IC (t)	0.0	0.0	0.0	0.0	0.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0
MD p.y.	400.0	298.0	84.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GVA (t)	0.0	0.0	0.0	0.0	0.0	1706.7	4341.7	3446.0	624.0	498.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0
Rubber interline: \$/M	2.68																				
MD p.y.	380.0	380.0	380.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GVA (t)	1204.0	1204.0	1204.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GVA	1204.0	1204.0	1204.0	0.0	0.0	1706.7	4341.7	3446.0	624.0	498.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0	1366.0
I-Depreciation	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2	-296.2
NVA	1402.2	1402.2	1402.2	296.2	296.2	1364.0	6079.9	3702.2	620.2	242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2
Total MD p.y.	760.0	640.0	632.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total ext. Labour	93.0	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I-Capital Labour	21.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I-Loan exte	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I = NAI	1202.2	1202.2	1402.2	296.2	296.2	1364.0	4377.9	2766.2	620.2	242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2	3242.2
Total NAI over 40 years for 4 ha	153 893.0																				
NAI sm.affholder/ind	2.1	2.3	2.7	1.9	2.3	6.5	14.6	9.2	9.4	9.5	17.5	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Average NAI/ha p.y.	956.6																				
Average NAI/ind	12.65																				

Source: author's calculations.

Appendix 4.

Economic calculation scenario with project (H1) (next page)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041		
International rubber price c.\$/kg	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140		
Price paid to producer c.\$/kg	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77		
Area in ha	20	21	22	23	24	25	26	27	29	29	30	31	32	33	34	35	38	37	38	38		
Situation asset project																						
Rubber																						
Revenue (€)	640.0	1495.0	1447.2	1407.0	1367.7	1328.3	1288.9	1249.5	1210.1	1170.7	1131.3	1091.9	1052.5	1013.1	973.7	934.3	894.9	855.5	816.1	776.7	737.3	
Investment and residual value (€)	474.0	4398.4	4487.3	4576.2	4665.1	4754.0	4842.9	4931.8	5020.7	5109.6	5198.5	5287.4	5376.3	5465.2	5554.1	5643.0	5731.9	5820.8	5909.7	6000.0	6090.0	
IC (€)	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	
Ind.p.s.	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	
GVA (€)	1648.0	4502.4	4381.3	4264.5	4151.3	4038.0	3924.7	3811.4	3698.1	3584.8	3471.5	3358.2	3244.9	3131.6	3018.3	2905.0	2791.7	2678.4	2565.1	2451.8	2338.5	
Rubber interline: 50/M																						
MD p.s.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
GVA (€)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
GVA	1648.0	4502.4	4381.3	4264.5	4151.3	4038.0	3924.7	3811.4	3698.1	3584.8	3471.5	3358.2	3244.9	3131.6	3018.3	2905.0	2791.7	2678.4	2565.1	2451.8	2338.5	
f. Depreciation	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	-258.2	
NVA	1389.8	4244.2	4123.1	4006.3	3889.5	3772.7	3655.9	3539.1	3422.3	3305.6	3188.8	3072.0	2955.2	2838.4	2721.6	2604.8	2488.0	2371.2	2254.4	2137.6	2020.8	1904.0
Total MD p.s.	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	
Total est. Labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
f. Cost est. Labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
f. Loan interest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
f. s. MAI	4354.2	4750.6	4675.5	4596.2	4516.8	4437.5	4358.2	4278.9	4199.6	4120.3	4041.0	3961.7	3882.4	3803.1	3723.8	3644.5	3565.2	3485.9	3406.6	3327.3	3248.0	
Total MAI over 48 years (net 4 ha) 103 892,9																						
MAI smallholder/m2	86.3	85.9	86.4	86.9	87.4	87.9	88.4	88.9	89.4	89.9	90.4	90.9	91.4	91.9	92.4	92.9	93.4	93.9	94.4	94.9	95.4	
Average MAI/ha p.s.	866.6																					

Source: author's calculations.

Appendix 5.

Economic calculation scenario without project (H2)

Assumptions without project

Area: 60% (2.4ha) - invest.: 80%
 Intercrop growing = 2/3 of area during 3 years
 No loan
 Rubber: yield: 70%
 Start of tapping phase 8th year

General assumptions

1 worker = 260 MD
 1 MD ext. labour: USD 1.25
 Intercrops: soya/sesame/corn
 Price : 1.8 \$/kg

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Situation without project																						
CASSB7	1,00																					
MD p.a.	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432	2432
GVA	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088	10088
Rubber																						
Yield (t/ha)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Revenue	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Investment and residual value (\$)	4212	-750	1290	-519	657	324	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
IC (B)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
MD p.a.	2400	2728	994	816	672	890	660	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
GVA	0,0	0,0	0,0	0,0	0,0	0,0	0,0	786	1822	2426	3174	3499	3499	3499	3499	3499	3499	3499	3499	3499	3499	3499
Rubber interline: SoFC																						
MD p.a.	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604	1604
GVA	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632	3632
GVA	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708	17708
Degradation	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890	890
NVA	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010	13010
Total md p.a.	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936	5936
Total ext. Labour	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732	732
Total ext. Labour	120	140	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Loan Interest	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I = MAI	12050	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070	12070
Total MAI over 40 years	432186,7																					
MAI smallholder/ha	826,2																					
Average MAI/ha p.a.	7,91																					
Average MAI/ha	7,91																					

Source: author's calculations.

Appendix 5.

Economic calculation scenario without project (H2) (next page)

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Situation without project																			
Area in ha	1,00																		
CHSSB/																			
MO p.a	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2	243,2
GVA	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8	1008,8
Rubber																			
Yield (t/ha)	110,2	1078,2	1048,1	1003,0	981,0	951,1	922,6	894,3	866,8	840,2	814,5	789,5	765,2	741,7	719,0	696,9	675,0	654,8	634,7
Revenue	3 425,9	3 320,8	3 289,9	3 051,1	3 024,4	2 931,5	2 841,8	2 754,4	2 669,9	2 587,9	2 508,5	2 431,5	2 356,3	2 284,6	2 214,5	2 146,5	2 080,7	2 016,8	1 954,5
Investment and residual value (I)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
IC (B)	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6	57,6
MO p.a	903,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
GVA	3 066,3	3 202,2	3 381,3	3 062,5	3 064,0	2 873,9	2 794,0	2 696,8	2 602,3	2 503,2	2 400,9	2 273,9	2 200,3	2 127,0	2 054,9	1 983,9	1 913,3	1 843,2	1 773,5
Rubber interline: SSIC																			
MO p.a	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
GVA	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
GVA	4 377,1	4 722,0	4 076,1	4 071,3	3 075,6	3 062,7	2 792,2	2 706,6	2 611,1	2 508,1	2 400,7	2 267,7	2 200,6	2 125,6	2 057,2	1 987,7	1 913,0	1 843,0	1 773,5
I - Depreciation	65,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0	63,0
NVA	4 308,1	4 200,0	4 010,1	4 002,3	3 006,5	3 000,7	2 729,2	2 643,6	2 548,0	2 445,1	2 337,7	2 204,7	2 137,6	2 062,6	1 994,7	1 924,7	1 850,0	1 780,0	1 710,5
Total md p.g.	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2	423,2
Total ext. Labour	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
I - Total ext. Labour	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8
I - Loan Interest	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I = MAI	4 305,6	4 199,2	4 006,1	3 996,0	3 000,0	3 000,0	2 710,8	2 625,3	2 529,5	2 428,4	2 320,7	2 197,7	2 130,6	2 057,6	1 987,7	1 917,7	1 843,0	1 773,5	1 703,5
Total MAI over 40 years																			
MAI smallholder/md	16,2	16,0	15,9	15,8	15,7	15,6	15,5	15,4	15,3	15,2	15,1	15,0	14,9	14,8	14,7	14,6	14,5	14,4	14,3
Average MAI/md																			

Source: author's calculations.

Appendix 6.

Economic calculation scenario without project (H3)

Assumptions without project 3

Area: 25% - Invest.: 50%
 Intercrop growing = 2/3 of area for 3 years
 No loan
 Rubber: yield: 25%
 Start of tapping phase: 8th year

General assumptions

1 worker = 260 MD
 1MD ext. labour: USD1.25
 Intercrops: soya/sesame/corn

Price: 1.8 \$/kg

Situation without project	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Area in ha	1.00																			
Chexf	677	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
MD p.a.	677	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
GVA	677	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
Rubber	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yield (t/ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Revenue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment and residual value (B)	-657	-487	-38.6	-39.5	-43.1	-32.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IC (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MD p.a.	700	74.0	419	34.0	29.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0
GVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubber Interline: 52/IC	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
MD p.a.	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
GVA	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883	2883
GVA	677	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NVA	677	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657	657
Total MD p.a.	332	296.2	282.2	188.0	80.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0
Total ext. Labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total ext. Labour	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labour interest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I = MAI	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677	677
Total MAI over 48 years	32 677.4																			
MAI smallholder/ind	24	24	32	33	34	27	27	29	34	36	39	40	40	40	41	41	41	41	41	41
Average MAI/ha p.a.	400.5																			
Average MAI/ind	3.56																			

Source: author's calculations.

Appendix 6.

Economic calculation scenario without project (H3) (next page)

	29	30	31	32	33	34	35	36	37	38	39
Situation without project											
CFSEF											
MD p3	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
GVA	630.5	630.5	630.5	630.5	630.5	630.5	630.5	630.5	630.5	630.5	630.5
Rubber											
Total (5 gha)	408.8	397.2	385.1	372.2	359.8	348.4	338.5	329.9	322.0	314.7	308.7
Fluctuation	116.8	109.9	103.5	97.4	91.3	85.9	80.7	75.8	71.0	66.2	61.5
Investment and residual value (€)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IC (€)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
MD p3	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
GVA	291.0	287.9	282.5	275.8	268.4	261.4	254.8	248.4	242.0	235.8	229.7
Rubber netlines: 5sHC											
MD p3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GVA	822.0	812.4	803.0	793.3	783.5	773.6	763.7	753.8	743.9	734.0	724.0
I-Depreciation	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
NVA	804.0	794.4	785.0	775.9	767.1	758.3	749.5	740.8	732.0	723.2	714.3
Total MD p3	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0
Total est. Labour	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0
I-Total est. Labour	1.3	2.5	3.8	5.0	6.3	7.5	8.8	10.0	11.3	12.5	13.8
I-Loan interest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I = MAI	902.8	893.0	883.3	873.9	864.9	856.1	847.5	839.2	831.0	822.8	814.8
Total MAI over 40 years											
MAI smallholder/ind	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Average MAI/ha p-3											
Average MAI/ind											

Source: author's calculations.

Liste of acronyms and abbreviations

ADB	Agricultural Development Bank
ADP1	Agricultural Diversification Project 1
ADP2	Agricultural Diversification Project 2
ALRO	Agriculture Land Reform Office
ARDB	Agricultural and Rural Development Bank
CDC	Commonwealth Development Corporation
CFD	Caisse Française de Développement
DRE	Dry rubber equivalent
FO	Farmers' organisation
GDRP	General Directorate of Rubber Plantations
GERUCO	General Rubber Corporation
GREL	Ghana Rubber Estate Limited
GRET	Groupe de recherche et d'échanges technologiques
GVA	Gross value added
KFW	Kreditanstalt für Wiederaufbau
MD	Man x day
NAI	Net agricultural income
NIB	National Investment Bank
NPFRP	National Plan for Family Rubber Plantations
NVA	Net value added
ORRAF	Office of Rubber Replanting Aid Fund
PM	Planting material
RDB	Rural Development Bank
ROAA	Rubber Outgrowers and Agents Association
RRIV	Rubber Research Institute of Vietnam
SAPH	Société africaine de plantations d'hévéas
SRPP	Smallholder Rubber Plantation Project
TCBP	Trade Capacity Building Programme
VBARD	Vietnam Bank for Agriculture and Rural Development