





Rubber works/FTA final report

An analysis and comparaison of the rubber smallholder sector in 5 countries: Cote d'Ivoire, Thailand, Indonesia, Vietnam and Cambodia

Executive Summary

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*1 CIRAD UMR Innovation *2 CIRAD UMR ABSys *3 CIRAD UR BioWooEB

Montpellier, February 2023

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1 Introduction and objective of the study

The FTA¹ programme is an international research program led by the CGIAR² and implemented by CIFOR³. This specific study called rubber works/Comparison 5 countries research program aims to gather data and information on the situation and current evolution of the natural rubber sector in 5 countries: Cote d'Ivoire (RCI), Indonesia, Vietnam, Cambodia and Thailand. It presents a typology of rubber based smallholdings in each country and describes farmers' respective strategies. This study provides elements for further policy recommendations in terms of rubber smallholder development.

The topics to be developed in priority in this report are the following: i) Implementation of a local/regional/national smallholder typology to cover all type of situations in the 5 countries, ii) Survey of agricultural sustainability standards and lessons for the rubber sector: economic stability, through income analysis and economic resilience, iii) the role of AFS (Agroforestry systems) in the rubber production and impact on farms resilience through diversification. The 5 countries have been selected to reflect various types of situation with i) Thailand and Indonesia from group A as the 2 historical leaders of world rubber production, ii) Vietnam and RCI from group B as the rubber booming countries with originally and historically a traditionnal Estate rubber system (1900 in Vietnam, 1954 in RCI) and iii) Cambodia from the groupe C as a recent rubber boom.

This specific study called "rubber works/Comparison 5 countries research program" aims to gather data and information on the situation and current evolution of the natural rubber sector in 5 countries: Cote d'Ivoire (RCI), Indonesia, Vietnam, Cambodia and

¹ Forests, Trees and Agroforestry : *http://foreststreesagroforestry.org/*

² Consultative Group on International Agricultural Research : *https://www.cgiar.org/*

³ Center for International Forestry Research : *https://www.cifor.org/*

Thailand. It presents a typology of rubber based smallholdings in each country and describes farmers' respective strategies. This study provides elements for further policy recommendations in terms of rubber smallholder development.

These 5 case studies with a farm typology approach showed that because they had different histories of rubber development and different contexts of production, the typologies of the rubber farmily farms were specific to each country. The practices observed in the rubber plantations were different, including the adoption of agroforestry practices. The role of rubber in the local farming system (and "activity system") varied but it was important and everywhere rubber remains an interesting crop for rural households. It was also clear that everywhere, there is still some reservoir of productivity. The importance of agroforestry is also investigated as it is highly linked with the level of farm income diversification.

2 Methodology

For each country, the data available before the project and the work conducted within the project are presented in table 1:

country	available information and work	Key persons from CIRAD	work done	Support	date of implementation
Ivory Coast	existing DB from 2019 FTA funding. Data analysis in 2001 with Noe Biatry from Istom/Agropariste ch	E Penot F Ruf J Sainte Beuve	database analysis income analysis using the software Olympe	1 IRC French student for 5 months in 2021 (based in France) for data analysis	2019 and 2021
Thailand	Over 1000 farms surveyed by B. Chambon between 2012 and 2018	B Chambon	Database analysis Households' typology and agroforestry practices		2021
Indonesia	100 surveys with focus on rubber agroforestry systems	E Penot	Private consultancy with former SRAP research assistant in West Kalimantan	with FTA Melia funding	2021
Vietnam	limited recent data available	B Chambon	FSS in 3 rubber areas: Binh Phuoc, Kontum and Quang Tri provinces Households' typology and agroforestry practices	Agreement for research collaboration with RRIV	2021
Cambodia	50 to 100 surveys. Two formers surveys in 2004 in Mimot and Kompong Cham. Value chain analysis and surveys in 2017 for AFD	E Penot B Chambon	FSS in 2 rubber areas: Mondol Kiri and Memot areas	French student from Supagro (Marie Gillot) with local student from RUA Partnership: DGR, RUA and WWF.	2021

Table 1: FTA/P2 country situation

Note: FSS=Farming System Survey, DB=Database, RRIV = Rubber Research Institute of Vietnam; RUA = Royal University of Agriculture

We develop in this study an approach to typologies of farm that aims to i) propose a farm typology based on farm structure and farmers 'strategy of income generation and ii) give an insight on the agroforestry practices, during both the immature and the mature period of the rubber plantations.

3 The Context

Low rubber price is a key problem for most smallholders since 2013. Rubber price evolution does depend on many factors: i) the demand and offer of natural rubber in the world where offer is slghtly above that of deman since 2018, ii) the state of local rubber stocks, iii) the state of global economy as the transport demand reflects the state of global economy, iv) the asymetric demand with China for more than 50 % of the world demand, v) the development of tyre production (low quality) in emerging countries, vi) the new rubber planting booms with effect on production 10 years after, vii) the price of oil and viii) the subtitution effect between natural rubber and synthetic rubber (classically assessed as 10 %).

Most rubber production is coming from smallholdings. Although they have often been at the origin of the development of the rubber sector in many producing countries, industrial plantations now represent only 15 to 20% of world production (IRSG, 2019). This model of industrial plantation, with a large part of the farms built during the colonial period between 1900 and 1950, is not expanding anymore except in Laos and Cambodia.

4 Thailand

It is the only country where rubber cultivation has been developed almost exclusively by family farms. This is largely due to the fact that it has never been colonized and that the Thai state has strongly supported these family farms adopting no policy to encourage private investment and large-scale industrial plantations throughout history (Fox and Castella, 2013; Chambon et al, 2018). Support for family farms in the South, the traditional cradle of rubber cultivation in the 1950s and 1960s, was also established for political reasons, mainly to counter the communist rebellion (as in Malaysia) and provide important sources of income for local farmers (Besson, 2002).

The data on the rubber-based households in Thailand illustrated the diversity of family agriculture which is well documented (Bosc et al, 2018). It showed that behind the generic term of family agriculture, there is a huge diversity. To characterize this diversity, we could identify four groups of farms with similar structure and strategies. The analysis highlighted that:

- whatever the group, there was a general strategy of diversification, which could be on-farm, off-farm or both. It was rare that the rubber-based households totally relied on rubber income. This is totally in line with previous studies conducted in Thailand for agricultural households in general (Masae et al, 2007) or for rubber households (Longpichai, 2013). Diversification provides some resilience to rubber-based family farms and ensures food security for households based on a cash crop (Longpichai et al, 2012);
- however, for all the households, in 2014 when the price was still not too low, the dependence on rubber income was high, rubber providing at least 54% of the

total household income. This was already reported by Viswanathan (2008) and could be a weakness for some farms;

the level of income generated by the off-farm activities was quite heterogeneous and more research is needed to understand which activities provide the best additional incomes, what are the conditions to access these activities and how the different activities and sources of income combine within the farm and the household.

In spite of the global changes and trends of evolution, this model of family farms has persisted and remained dominant in Thailand although the future may probably be towards more family business farms relying on permanent hired labor (Chambon et al, 2018). This would emphasize the issue of the labor working in the farm, especially for latex harvesting: who will be the tappers? and how will the family business farms be able to secure the labor for harvesting their rubber plantations?

Regarding agroforestry practices, although it was recommended by the rubber authorities, intercropping during the immature period of the plantation was not systematic for all farmers nor all the plots of the farmers. In addition, intercropping during the immature period was not automatically followed by the settlement of a rubber agroforestry system (RAS) during the mature period of the plantations.

Despite their potential interest, permanent RAS were still little adopted by Thai rubber farmers. Although there was a tradition of agroforestry in Southern Thailand, it was almost totally replaced by rubber monoculture with the implementation of the rubber replanting scheme. However, for the past 20 years, change in the farmers environment (government measures, rubber prices, research interest) created a more favorable context for the development of RAS. Farmers' initiatives opened way for a change of rubber cropping system which needs to be supported by research and extension services. There was also a global trend to promote the RAS with strong involvement of environmental NGOs (see for instance Wang Mei Hua et al. 2021) notably in the framework of the Global Platform for Natural Sustainable Rubber (GPSNR).

5 Ivory coast

The seventh largest producer in the world and the largest in Africa, Côte d'Ivoire produced 603,000 tons in 2017, representing just over 4.5% of world production. Created during the colonization in the 1950s', the rubber industry was developed by the agro-industry during the second half of the 20th century from 1954 with the withdrawal of investments in ex-Indochina. Structural adjustments have led to major investment programs with the World Bank and other development assistance structures, which have supported the development of village plantations. At the end of the 20th century, the State withdrew from the sector, in parallel with its liberalization (Traoré, 2018). With an average annual growth rate of 19.8% over the last 10 years, Ivorian production is increasing strongly, almost linearly. Cultivated village areas are increasing significantly in replacement of ageing cocoa areas and through the planting of marginal areas⁴. Village plantations are being expanded and the country's rubber processing capacity has increased (Traoré, 2018).

Family farming is already diversified as made up of planters generally owning 2 to 5 hectares of rubber trees (often coupled with cocoa to ensure a regular income) and is

⁴ Not located in equatorial region between 10°N and 10°S

characterized by complex logics, involving personal choices linked to household needs and to their own strategy regarding the production system (Gasselin et al., 2015). These logics strongly influence production, and it is therefore fundamental to analyze them, in order to understand the reasons which push these "small farmers" to adopt certain cultivation methods, but also to plan themselves to determine the medium-term trajectory of the crop and of their farm, in a particular economic and ecological context. These reasons may, for example, involve other performance indicators: output is no longer necessarily the benchmark for the productivity of the system, but the valuation of the working day (monetary unit / hour of work) becomes so.

The modeling of farm operations, the final objective of the study, is based on the structure of medium-sized farms created. It offers several scenarios to be tested to show a future for the farms concerned. Finally, a prospective analysis testing various scenarii of structural and economic changes was carried out with the Olympe software This study sought to determine the new importance of rubber cultivation in the income of rubber planters in Ivorian family farming, traditionally focused on cocoa cultivation. The place of rubber trees is becoming more and more central in the Ivorian agricultural landscape of perennial crops, and this trend continues to be maintained. The reasons for this adoption are multiple, and can be explained not only economically, but also ecologically. Analysis of the results showed the large number of reservoirs of productivity of small rubber plantations in Côte d'Ivoire. From sale at the official price through the establishment of agroforestry systems, rubber systems have significant leeway to continue to innovate and improve their productivity. Different levels of priority have been established: it seems more relevant to deal with the current problems encountered by growers, before establishing or promoting new rubber systems.

There are many possibilities for implementing agroforestry systems based on rubber trees, and those presented in this work are only a part of them. The growers themselves are often the source of innovation processes, and a participatory approach would be necessary to understand their choices and their potential reluctance to adopt new cropping systems. For historical reasons, there has been no local tradition of agroforestry rubber systems: nevertheless, the fact that some cocoa producers already have agroforestry practices shows that they do not hesitate to adopt agroforestry when adapted and necessary.

The diversification of farm income for better resilience to the volatility of natural rubber prices is the main asset of the "SAF Fruit trees" scenario described, and this type of system could respond to the desire to promote the sustainability of rubber cultivation at international scale. It is therefore necessary to continue research work on these systems, by studying their agronomic and economic performances and their social impacts on family farming. The impact on planters of a lack of structuring of the rubber industry was underlined: the "collector" price offered by sales intermediaries is the main factor in the differences in economic performance noted. This could potentially happen again if rubber prices rise again, triggering a new wave of rubber plantations.

The Ivorian rubber industry must therefore face new challenges, including in particular the correct estimation of the quantities of raw rubber material to be processed. Tracing all of the village planters and production is a key step in achieving an optimal chain organization. A partnership between planters, rubber processors and public authorities would benefit from being put in place with a view to Côte d'Ivoire becoming a benchmark country for rubber cultivation on the world market.

6 Cambodia

Cambodia, the region's tenth largest but historic producer, produced 193,200 tons of natural rubber in 2017, which represented 1.4% of world production. As in most ASEAN countries, the first plantations were established at the time of colonization on the model of large private plantations, nationalized at independence (1953) and privatized in the 2000s. From the 2000s onwards, the family plantation model developed, with the obligation to sell the production to the factories of public companies until 2005 (CRDI, 2009; Delarue, 2009). A concession policy in the Mondol Kiri and Ratanakiri areas since 2010 has led to a strong development of private industrial plantations of more than 1,000 hectares. It should be noted that the historical plantations are located on red ferralitic soils, with a very high water retention capacity.

Since 2007, there has been a public policy aimed at developing the 19 sectors most favorable to exports, including rubber. It has been reintroduced into the 2014-2018 trade integration strategy (CTIS, 2013). As a result, the average annual growth rate has been very high over the past decade, approaching 49% with the colonization of Mondolkiri and Ratanikiri provinces at the detriment of local forests.

In 2008, the State sold several of its "historic" concessions and companies to the private sector. There are therefore three categories of plantations in Cambodia: private industrial plantations (large historical plantations), economic land concessions (ELC) with medium and large plantations and small family plantations. The ELC policy was very close to that developed for oil palm by Indonesia since the 1990's. Such policy has triggered a very large deforestation of the 2 provinces where forest were still important : Mondol Kiri and Ratanakiri.

The four main rubber provinces (based on planted area) are Tbuong Khmum, Ratanakiri, Kampong Thom and Kratie that together account for 69% of the planted area. Four other significant provinces include Kampong Cham, Mondulkiri, Stung Trang and Preah Vihear that together account for another 24% - a total of 93% of the country's plantings. The less than 2 ha smallholders are the majority by far, but account for only 13% of the planted area. Regardless of their contribution to overall production, they represent a category that cannot be overlooked when developing a national development strategy.

In conclusion for Cambodia, rubber is a key strategic crop for smallholder rubber farmers but it is not the only one: 49 out of 78 farmers have income diversification (agricultural activities and off farm activities). However, there is no agroforestry practices during the mature stage (such as those in Thailand or Indonesia) due to lack of traditions and no knowledge or skills from smallholders. Traditionally, extension promotes rubber monoculture only. Therefore, it is key to combine the support for rubber production with the promotion of other crops and farm activities (to build resilience and capacity to adapt in respect of further economic shocks). It should be interesting to promote large scale agroforestry practices through on farm trials and potentially an innovation platform to boost these techniques. Promoting agroforestry practices includes to promote tree species intercropping in rubber plantation and provide licenses for timber commercialization.

Beside the ELC concession policy, it seems necessary to develop land-use management across different scales with rubber as one element of a sustainable agriculture (based on diversification), from plot to watershed levels. Two topics are key to develop a sustainable rubber sector; i) to improve smallholder access to the rubber market for quality planting material and ii) to Improve tapping management: avoid early opening, ensure more consistent use of stimulation and improve tapping quality. Most farmers have very limited possibilities of investment due to low cash balance. Income diversification through agricultural activities (cashew nut, annual crops...) and off farm activities remain key components of total net income.

In term of research, the agenda should include the following point; i) to Identify rubber varieties that match specific soil quality and explore the better management of soil fertility, ii) a better understanding of the factors that enhance agricultural diversification and evaluate the environmental, social, and economic benefits of agricultural diversification, iii) to conduct economic analyses of rubber production + comparative analysis with other crops and association between rubber and high-value timber, iv) to examine the possibility to improve access to domestic and international rubber markets and v) to examine the role of non-farm activities in labor diversification and income formation mechanisms

7 Vietnam

Vietnam has recently become the third largest producer country in the world with more than one million tons and 8% of world production. Rubber cultivation has developed there under French colonization, during the Indochina era, on the model of private concessions, mainly in South Vietnam and in the famous Red Lands region of Cambodia. At the end of the 20th century, after 1975, a major agrarian reform combined with the advent of the market economy led to the development of small village plantations, encouraged by public policies (Fox and Castella, 2013). These policies continued in the 2000s, preferring rubber to other speculations such as pepper, coffee and other fruits (Dao, 2015). Industrial plantations would represent 40% of the area currently planted. The rubber sector is very dynamic, with an average annual growth rate of 8% during the last 10 years. The political will to develop rubber is very strong, considering it a strategic crop and an opportunity to improve the social condition of rural households and the country's balance of trade.

Smallholders developed quickly since 2006. Rubber produced by smallholders is crucial to the industry. In 2019, there were approximately 265,000 rubber growers in the country, with a total area of 479,566 ha. They represented 51% of the country's total rubber plantation area. In the smallholder rubber area, approximately 426,000 ha were in the tapping stage, with an annual latex supply of about 732,300 tons, accounting for 62% of the total amount of latex produced in Vietnam.

Although it was limited to three areas and limited by the size of the sample of farmers interviewed, this study brought interesting highlights. The households involved in rubber cultivation were primarily rubber farmers. They considered rubber as their main activity and got the majority of their income from rubber although we could observe some diversification strategies at different levels (plot, farm and/or household) in the households interviewed. Despite the rubber price fluctuation, the interest of some rural households for rubber cropping continues to be strong and rubber remains an

important economic activity for the households. We should mention however that after 2016, because of the continuous fall of rubber price after the historical high peak in 2011, some farmers abandoned rubber for other crops (Hoa, 2018). With our small sample, we could not observe such dynamics. Although the rubber price was still in a low trend, the incomes generated by rubber plantations allowed many households to be in a better economic situation than the average households in Vietnam. This may explain the continuous interest of some farmers for rubber.

The general use of clones (with a high potential of productivity) contributed to the good economic performances of the rubber plantations. Even if they were not always optimised, the agronomic practices (use of fertilization, tapping system, agroforestry) also allowed having a good gross margin.

Agroforestry practices combining crops with rubber trees on the same plot were limited to the first three or four years of the plantation. These practices were motivated by economic reasons. From the end of the immature period and during the mature period of the plantations, many farmers considered that the intercropping was not possible. Farmers had limited knowledge in particular on long-term agroforestry practices. However, it was interesting that some farms developed agroforestry systems based on livestock and that these systems, adopted in areas where conditions were less favourable to rubber cultivation, allowed generating a gross margin for rubber plantations close to what could be achieved in favourable conditions. This clearly shows the role that agroforestry practices could play to allow rubber smallholders have a better valorisation of their rubber plantations, in particular when they were established in conditions that limit the yield and therefore the income from rubber trees. There is still a lot of research activities to conduct. In particular it would be useful i) to identify some appropriate agroforestry systems to be developed considering the biophysical and the socio-economic situation of the smallholdings and ii) to share the information with the farmers (who clearly lack this information) and encourage them towards agroforestry when it could be an option to increase the income and livelihoods of the households. In a context of increasing concern on the environmental impact of rubber cultivation, a multi criteria analysis of some promising agroforestry systems would be of high interest to support the rubber smallholders in their way towards sustainable natural rubber.

8 Indonesia

Indonesia has been the world's second largest producer for many years, with 3.4 million tons in 2017, or 25% of the world's natural rubber production. As in many countries in Southeast Asia, rubber tree cultivation was developed under colonization in the form of "domains". At the beginning of the 20th century, natural rubber prices were very volatile, which pushed tire manufacturers to internalize the production stage. In Indonesia, this was the case with Goodyear (Barlow, 1978). Small family farms very quickly adopted this crop in the 1920s, reaching 85% of the country's total area (Fox and Castella, 2013; IRSG, 2018). In the 1960's some of the large plantations were nationalized to form the state-owned company "PTP" (PT Perkebunan Nusantara III). The State implemented concession policies promoting the development of oil palm in the 1990s, contributing to massive deforestation (Byerlee, 2014; Feintrenie *et al.*, 2010). Over the last decade, natural rubber production has increased at an average rate of 2.4% per year, with a slight slowdown in growth since 2013. This growth is due

to the conversion of land initially dedicated to cocoa, tea and coffee into plots of rubber, but also oil palm and Acacia mangium (Feintrenie et al., 2010). The slowdown is caused by the reduction of available land and competition with other speculations. Yields in Indonesia are reported to be lower than in other producing countries, mainly due to the use of les productive genetic material in jungle rubber, the ageing of the trees and the competition in terms of replantation with oil palm. BPS statistic mix up jungle rubber plantation with a yield of 500 kh/ha/year with clonal plantations (average yiels between 1.2 and 1.8 ton/ha/year). Therefore the average yield generally presented for Indonesia does not reflect the reality of two types of plantations co existing. Industrial plantations represent only 14% of the area planted with rubber trees Beside the traditional jungle rubber, an environmentally perfect RAS but economically obsolete and currently rapidly disappearing, many farmers were interested in RAS with clones since the 1990's. Most farmers do refer to positive externalities for agroforestry practices that enable to maintain soil fertility, reduce erosion and enable a better use of water. So far, agroforestry practices trough diversification has clearly increased farm resilience according to previous farming system surveys.... But another type of diversification with the "complex oil palm/rubber" has globally played the same role leading to probably less interest in agroforestry, in particular in remote places with limited access to markets.

Today, all forest and most jungle rubber have disappeared in the study area to the profit of roughly 2/3 of the area with oil palm and 1/3 with clonal rubber, either in monoculture or agroforestry. In the region under study, the major change in land use and farmers' strategies has been clearly the rapid and significant development of oil palm which quickly became the priority number one for local smallholders. In the meantime, local estates took over most of the available land for their own oil palm plantations. Meanwhile, low rubber price hampered any interest in rubber cultivation. Despite this situation, smallholders did not want to abandon rubber definitively. Rubber is still planted, as it provides a use of largely available family labor, in complement of that used for oil palm production and income diversification (monoculture and RAS 2 mainly) even if return to labor is less favorable.

We are back in 2021 to the same problems and same situation that we faced in 1994: poor access to clonal planting material, no training on tapping frequency and practices but with some knowledge on clones and AF practices. It seems that there is no transmission of rubber cultivation techniques to young farmers and children. Agroforestry practices have been considered as very interesting for most farmers: i) during the immature period of rubber trees, for a better valorization of land with intercrops or reduced costs of establishment depending on the type of RAS and 2) income diversification (either for self-consumption or marketing, for some fruits and timber) and improved farm resilience and less dependency to commodity price volatility. The lessons learned are the following : i) Rubber agroforestry trials came right in time in 1994, with a strong demand from farmers for systems providing low establishment cost and income diversification: the right time at the place, BUT....ii) Oil palm came in 1997 with a very strong pressure from companies (through the policy of concessions) providing a lucrative alternative to rubber cultivation with full credit (but loss of land) and better return to labor, iii) Interest in agroforestry practices remains high for old men but no interest is witnessed from younger generation, iv) It is now time for rubber replanting as trees are old, and the same old story remains (access to planting material), v) Good tapping practices (tapping school and training, technical information on panel management, upward tapping) are essential to be able to maximize tree lifespan up to 35 years long, vi) Important impact of white root and other root diseases in areas with forest or old jungle rubber before plantation and vii) Low rubber prices especially compared to palm oil do not help in maintaining farmers' interest in rubber cultivation.

Three major questions are clearly part of the research agenda: i) What is the impact of fruit production from agroforestry systems on food security and diet quality of local families, as well as on farmers income. Ii) What is the impact of timber production, both for self-consumption in households and marketing, and iii) To what extent such AF systems are able to provide better climatic resilience for both rubber and intercropped varieties?

The 2021 socio-economic survey on all former SRAP farmers and a sample of SRDP⁵ farmers shows that: i) oil palm had a tremendous impact on farmers strategies and income becoming the first priority for most SRAP farmers (less for SRDP farmers who were well trained on rubber and had a really good income from their clonal rubber), oil palm is now covering 2/3 of the perennial crop area in Sanggau district for instance ii) the disappearing of jungle rubber, no more tapped and considered as a land reserve for future planting, and iii) the move to clonal rubber and the maintaining of rubber as diversification. The perception analysis on agroforestry practices shows that RAS are considered as a mean to reduce potentially rubber establishment cost and provide more income diversification at farm level (more resilience to price volatility) during the whole rubber lifespan. But it requires local studies on available markets (Durian, Gaharu, Duku...) and new emerging markets for associated trees in RAS (Pekawai, Petai, Jengkol, timber trees).

It is quite clear that the long period of low rubber price which occurred since 2013/2014 did not help in favoring clonal rubber plantation, in particular for young generations. However, old farmers remain convinced of keeping both crops (rubber and oil palm) in their production systems. But it is clear that a longtime low rubber price period and the oil palm boom had a significative impact on farmers choice on rubber in general and RAS in particular.

9 Global conclusions.

These case studies from five different rubber producing countries showed that because they had different histories of rubber development and different contexts of production, the types of rubber farmily farms were specific to each country. The practices observed in the rubber plantations were different, including the adoption of agroforestry practices (which remains globally limited). The role of rubber in the farming system and the activity system varied but it was important and everywhere rubber remains an interesting crop for rural households. It was also clear that everywhere, there is still some reservoir of productivity.

Several states have public policies to support and/or control rubber production and expansion (Thailand with RAOT). However, few public policies seem to exist concerning rubber production sustainability despite the recent international initiave on that topic called GPSNR. At the same time, the biggest companies of the rubber sector

⁵ SRAP is the Smallholder Rubber Agroforestry Project, a research program developed by CIRAD and ICRAF from 1994 to 2007. SRDP is the Smallholder Rubber Development Project, funded by the World Bank from 1980 to 2000.

are adopting new policies of sustainable supply chain management (Michelin.Continental with the initiative "rubberway" for instance).

If states want to take part in the current process of rubber supply chain improvement, Gitz (2019) has identified four determinants factors:1) limiting negative impacts of landuse change, For instance, rubber is a good alternative to oil palm in Indonesia, ii) regulating land concessions (no more concessions in Indonesia since 2015) and contract farming (to limit expansion of poor ELC in Cambodia for instance), iii) Supporting smallholders and farmer groups : a real necessity to improve access to better training on tapping systems and techniques (in the five countries) and access to good quality improved planting material (Indonesia and Cambodia), to improve rubber marketing and sourcing (RCI) and iv) Promoting and improving diversified systems in particual agroforestry for better gross margin /ha, more positive externalities and globally better environment oriented systems. Rubber is already in most area a "real green " product. More generally, rubber plantation management has to be thought at an inter-sectorial coordination at the landscape, country and regional levels.

New approaches and modalities provide opportunities for such coordination to take place in practice (e.g., landscape level planning, integrated watershed management, integrated and participatory land use planning, decentralization, etc.). In order to have a real impact, political will is a prerequisite for the success of these approaches in particular in Indonesia and Cambodia where extension is not anymore existent.

Local governments need to enhance their role as facilitators in encouraging all sectors and stakeholders to proactively participate in broader natural resources management. Rubber is an excellent client for agroforestry systems that provides both better income /ha and better environmental externalities and outputs.

The diversity of farming systems shows that beside general global requirements for all the rubber sector (access to credit, clonal planting material, tapping system training, agroforestry techniques....), local specifities for each farm type need to be taken into account:

For states and extension:

- Develop a good access to clonal planting material in Indonesia and Cambodia: and generalize village budwood gardens and promotion of private nurseries with access to certified budwood gardens.
- Access to high variety of clones adapted to local conditions or uses in all countries taking into account cropping patterns (monoculture vs agroforestry), adaptation/mitigation to climati change, presence of leaf and root diseases
- Promote tapping schools and ensure that the farmers and the tappers have access to good technical information on tapping techniques such as tapping quality, low frequency method using stimulation, upward tapping etc.
- Promote public research and development policies that promote the development of diversified rubber production systems inclusing agroforestry systems
- Support smallholders and farmers groups to improve access to information, improve rubber production efficiency, and make farming systems more sustainable
- increase development of producers' union and/or cooperative, or other form of farmers structuration for a better information on marketing and cropping/tapping techniques.

For reseach institutions:

- Identify the right clone at the right place: taking into account new environment with climatic change, and adapted to local conditions
- Conduct research on various plantation technical models or patterns in order to promote the development of profitable alternative types of plantations including various types of agroforestry systems with normal planting density, double spacing...
- Study (and implement through on farm trials) multi-criteria analysis of possible agroforestry systems for mature plantations to develop for more sustainable rubber plantations
- Participate through value chain studies to the assessment of the socioeconomic and environmental impact of the rubber value-chain :
 - \rightarrow develop a farming system reference network to follow up farming systems trajectories and changes
 - \rightarrow assess the impact of any certification on the value chain and particularly on the smallholdings
- Evaluate the adaptation of the development of rubber tree to climate change and its impact of leaf disease, white root disease in RAS, etc

For the civil society

- Developping innovation platforms as a common tool at the value chain level with all value chain actors to promote innovations and required adaptation (to climatic changes or move to agroforestry patterns for instance).

In Indonesia and Cambodia:

- Promote coherent land use planning policies that are going towards the development of sustainable rubber value-chain : to promote an hamonious co development of oil palm and rubber in Indonesia and organize a better land use between smallholders and concessions in Cambodia.

In Laos, Cambodia, Vietnam and RCI

- Promote agroforestry systems to diversify sources of income and increase global farm resilience.