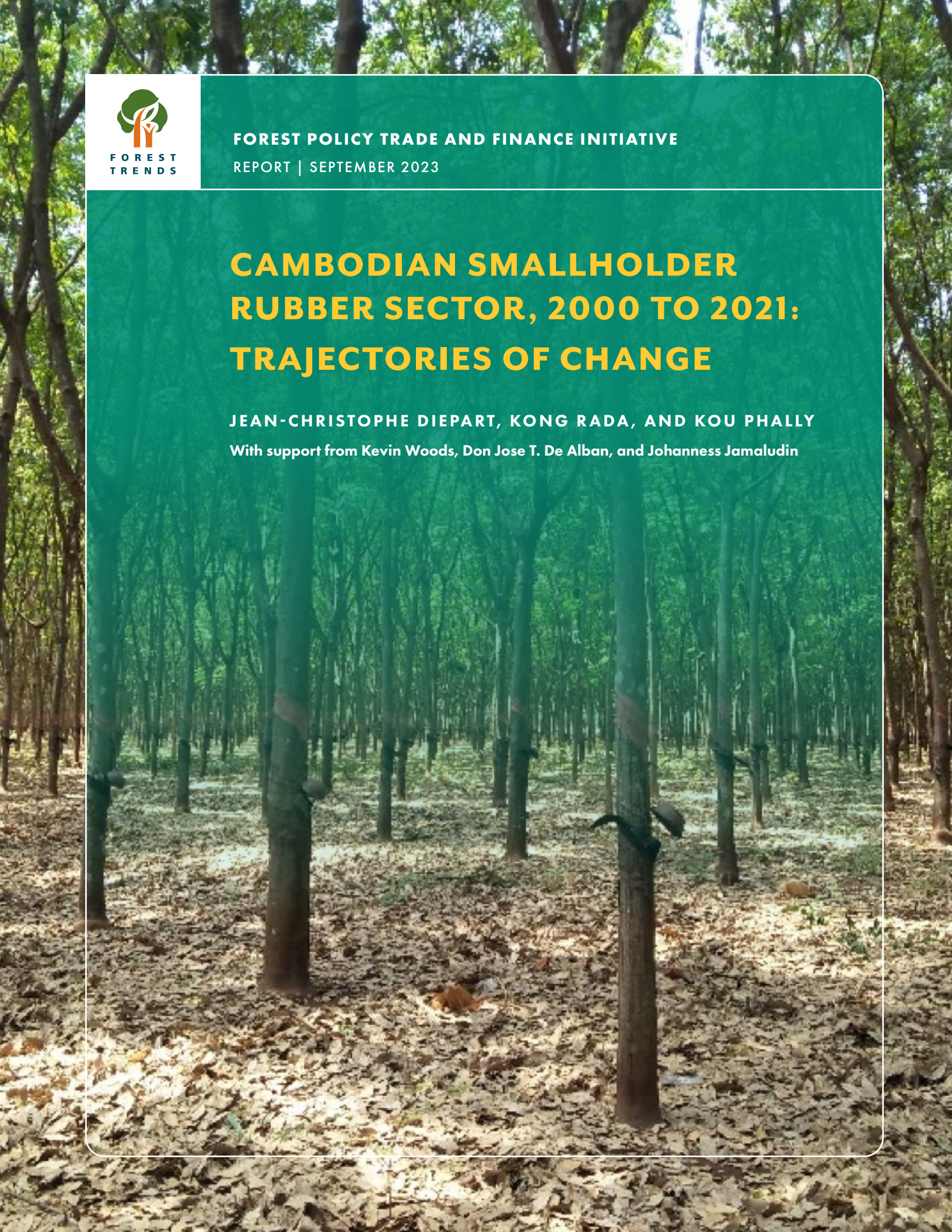


FOREST TRENDS

FOREST POLICY TRADE AND FINANCE INITIATIVE

REPORT | SEPTEMBER 2023

CAMBODIAN SMALLHOLDER RUBBER SECTOR, 2000 TO 2021: TRAJECTORIES OF CHANGE

JEAN-CHRISTOPHE DIEPART, KONG RADA, AND KOU PHALLY

With support from Kevin Woods, Don Jose T. De Alban, and Johanness Jamaludin

Acknowledgements

The authors would like to thank all those who supported the project and made this research possible. The core research team consisted of Jean-Christophe Diepart, Kong Rada, and Kou Phally of the General Directorate of Rubber. Phally worked tirelessly in the field and was key in making links with provincial authorities, owners of several rubber processing plants as well as representatives of rubber cooperatives we had a chance to meet. He passed away tragically in January 2023 and we dedicate this report to him.

We are particularly grateful to all the respondents who generously offered their time to respond to our questions. Thanks are also due to the General Directorate of Rubber who has shown a keen interest in this research since the beginning and hosted two validation workshops with key stakeholders. We also thank the participants to these workshops for engaging with our research and providing valuable comments.

Forest Trends would also like to thank the reviewers who generously gave of their time to enrich this report (in alphabetical order): Naomi Basik Treanor, Kerstin Canby and To Xuan Phuc (Forest Trends), Eric Penot (CIRAD), and Bénédicte Chambon (CIRAD). The authors alone are responsible for any errors of fact or interpretation. The authors are also grateful to Jan Taylor and the Forest Trends Communications Team for copy editing, and Sarah Yang (Forest Trends) for assisting with design and layout.

This research was conducted under a grant from the Norwegian Agency for Development Cooperation (Norad), “Reducing the impact of large-scale agricultural investments in the Mekong region on communities, forests, and climate change” (2018–2021), which aimed to reduce deforestation, wildlife habitat destruction, land grabbing, and human rights abuses in the Greater Mekong subregion linked to natural rubber production, processing, and trade.

The views expressed in this publication reflect those of those of the authors and do not necessarily reflect the views of funders or external reviewers.

FUNDED BY Norad NICFI Norway's International Climate and Forest Initiative

Table of Contents

List of Figures

List of Maps

List of Tables

Acronyms

DRC	Dry Rubber Content
ELC	Economic Land Concession
FoB	Free on Board
GDR	General Directorate of Rubber
GVA	Gross Value Added
LULC	Land Use Land Cover Change
MAFF	Ministry of Agriculture, Forestry and Fisheries
NORAD	Norwegian Agency for Development Cooperation
ODC	Open Development Cambodia
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
RSS	Ribbed Smoked Sheet
SHR	Smallholder Rubber Farmer
SOE	State Owned Enterprises
SORE	State-Owned Rubber Estates
TSR	Technically Specified Rubber

Executive Summary

In Cambodia, rubber production plays a strategic role in the country's agricultural development, influencing land use, employment as well as the overall export-orientation of the country's agro-industry. While rubber production occurs on large-scale estates (Economic Land Concessions and privatized State-Owned Enterprises), the government has prioritized smallholder rubber production as a key contribution to the National Strategic Development Plan.

The sector remains dominated by large estates but smallholder rubber contribution is significant. According to official figures, as of 2020, 735,000 hectares (ha; 76percent) of the land area designated for rubber production had been granted as economic land concessions, 66,000 ha (7percent) as former state-owned enterprises (now privatized), and 161,000 ha (17percent) as smallholder rubber landholdings. By 2019, there were 32,100 smallholder rubber households cultivating a total area of 161,103 ha of rubber, 74percent of whom have a rubber landholding smaller than 4 ha. Smallholder rubber households are relatively more effective than large estates in turning land into actual rubber plantation. As of 2020, smallholder rubber landholdings represented 36percent of the total rubber area actually planted in the country.

The entire sector suffered a downturn after rubber prices peaked in 2011. Yet no study in Cambodia has examined how this downturn of the last decade has affected the dynamic of smallholder rubber as it relates to the land-use/land cover dynamics, smallholder livelihoods, and the value chain to which smallholders contribute. The report aims to fill this knowledge gap. It brings together the findings of a field-based research project conducted in 2020 and 2021 in three smallholder rubber hotspots in Cambodia (Kampong Cham/ Tbong Khmum, Kratie, and Ratanak Kiri provinces).

We examine three interrelated topics. At the landscape level, we conducted a land cover and land-use change analysis to contextualize rubber in the overall dynamic of land systems of Cambodia over the past two decades and to understand the extent to which rubber price dynamic has acted as a driver of deforestation. At the smallholder farmer level, we examine how the rubber price drop influenced the socio-economic differentiation between smallholder rubber farming systems and impacted their income and livelihood. At the rubber value chain level, we looked at how rubber prices influenced the creation and distribution of value added along the different segments of the commodity chain (e.g., from production to export).

LAND COVER CHANGE AND LAND-USE PATHWAYS AT LANDSCAPE LEVEL

While rubber is typically recognized as the key driver of land cover change and deforestation during the study period, our analysis shows a more complex picture.

We highlight intensive transformation in land systems over the period 2000–2020. More than half (56percent) of land in the area studied, totaling 31,071 ha, has undergone a change in cover at least once. Deforestation

and forest degradation account for 77percent of this land cover change area, including transition from forest cover to rubber accounting for only 17percent. A more significant area of new rubber comes from the replacement of old rubber plantations established before 2000 or from the conversion of other crops (e.g., cashew) to rubber. Rubber-driven deforestation has declined since 2013 and in areas outside Economic Land Concessions (ELCs), cashew has become a key "pioneer crop" (i.e., deforestation driver).

The transformation of land cover and land use related to rubber is caused by multiple interacting factors that operate at local, national, or global levels. The market price for rubber is an initial direct driver of land cover change, but it is by no means the only one. Its role and influence are mediated by several other variables that pertain to either the social or biophysical dimension of the land systems in these rubber landscapes, namely, the market dynamics of rubber and other crops; migration of smallholder farmers to upland areas; ELC implementation; land titling; soil quality; and the existence of a forest frontier. The relative importance of each of these variables changes over time.

The actual land-use changes on the ground are the contingent outcomes of interactions between multiple drivers. We identify three distinct pathways of land-use transition related to smallholder rubber in Cambodia: via the development of smallholder rubber in forest pioneering driven by migrants, in landscapes transformed by Economic Land Concessions, and in a shifting cultivation landscape.

AGRARIAN TRANSFORMATIONS AT SMALLHOLDER FARMER LEVEL

This diversity of evolution at the household level is caused by multiple interacting factors that concern the timing of their installation — which has an important bearing on the size and type of land they can acquire — and their capacity to invest in rubber production.

The general category of "smallholder rubber farmer" erroneously conveys the idea of a homogenous group when compared with ELCs. But, in fact, this categorization hides a large diversity of livelihoods and ways of well-being. We captured a pattern of differentiation that allows for the identification of three main categories of smallholder rubber farmers based on the total size of their agricultural landholding: large landholdings (more than 10 ha), medium-sized landholdings (5–10 ha), and small landholdings (less than 5 ha). The rapidity with which this socio-economic differentiation process took place is striking. Primarily, it is due to the concomitant convergence of migration, rubber price, and titling. The differences between these groups are huge in terms of livelihood — ranging from households living in a lavish villa, with big cars and children studying at university in Phnom Penh, to families living in a small shelter struggling to make ends meet.

The measurement of rubber production economics is based on notions of "value added," which indicates the wealth created during the production process. We computed and compared economic data between two market phases corresponding to two distinct price levels ("boom" prices of US$2 per kilogram (kg) dry rubber content, or DRC, and "bust" price of US$1.3/kg DRC.) The value added varied from US$1,763–2,079 per ton DRC in the boom phase and from US$1,159–1,374 per ton DRC in the bust phase, or a decline of 33–34percent between the boom and bust phases. The value added varies more between districts than between rubber landholdings in each district. This is because the yield profile heavily influences the total

value added. As far as farmer incomes are concerned, they varied between $US745–1,267/ha/year in the boom phases and US$420–756 ha/year during busts, or a decline by 39–43percent.

In terms of adaptation, a key observation is that the sale or the leasing-out of rubber land or the cessation of tapping is not an option for the vast majority of smallholder rubber farmers, simply because they cannot afford it. This logic greatly differs from the situation of large plantations that have often stopped their processing operations when the rubber price falls too low. This contrast reveals the strategic importance of smallholder households in supporting the sector. On the other hand, we observed that the different smallholder groups identified above adapt differently to the decline in the rubber price. Households with large landholdings tend to adopt long-term strategic mechanisms (e.g., expanding agricultural landholdings including for the production of rubber), while those with small landholdings rely on short-term responses, such as more off-farm wage labor, a reduction in maintenance costs, etc.

RUBBER VALUE CHAIN DYNAMICS

Two main methods are used to convert latex into processed rubber before export: conversion into Ribbed Smoked Sheets (RSSs) and conversion into Technically Specified Rubber (TSR). RSS (which accounted for 92 units in 2016) and TSR processors (accounting for 37 units in 2016) will usually utilize latex produced on their own plantations. The purchase of additional latex or coagulum from smallholder rubber farmers is contingent on the purchase price, the distance between the smallholder plantation and the processing unit, the availability of transport for latex (usually organized by the processing unit), and the accessibility of technical equipment to produce TSR from coagulum.

However, the bulk of latex tapped daily in Cambodia, particularly with respect to smallholder rubber farmers, is not processed in RSS or TSR units but coagulated on-farm and sold to local collectors who take it directly to Vietnam. This is a central feature of the rubber value chain in Cambodia. In fact, the value chain is organized to encourage rubber farmers to proceed with on-farm coagulation of their production. First, a small price differential is actively maintained to put coagulum at an advantage over latex. This intervention in the market is managed through an opportunistic and strategic arrangement between influential traders on both sides of the border. Cambodian traders who export unprocessed rubber gain from the transaction as well as the growing Vietnamese rubber processing industry that triggers demand.

The decline in rubber prices on the international markets has had an immediate effect on the value added for producers, who have become more sensitive to small price differences. It has reinforced the advantage of coagulum over latex. The decline in rubber prices is concomitant with the large increase in rubber production that has resulted from the significant area of rubber planted in 2008–2013 becoming mature in 2014–2019. This gave a small inducement to exporters to maintain the price of coagulum at a higher level than that of latex, despite the overall decline in the rubber price.

However, this general pattern is not homogenous across the rubber landscapes of the country. The distance to the Vietnamese border is quite influential: the closer to the border, the higher the density of traders, and the higher the incentives for smallholder farmers to undertake on-farm coagulation, even if the distance between the smallholders' rubber plantation and the processing unit is within one-day reach. In contrast, in regions where there is a history of collaboration between processing industries and smallholder rubber

farmers (and thus greater trust), the premium price obtained if a high grade of rubber is produced can be transmitted to farmers, which incentivizes them to sell latex.

LEGALITY AND WAYS FORWARD

The nuanced dynamics of the smallholder rubber sector are often poorly understood by downstream rubber industry stakeholders who, with the best of intentions, have committed to eliminating rubber linked to deforestation (or at the very least, illegal deforestation) from their supply chains. Our analysis shows that rubber's role has stopped being a primary driver of deforestation since 2013 in Cambodia. To be clear, deforestation has continued unabated, but it is now driven by other annual and perennial commodity crops, such as cassava and cashew. A nuanced and careful analysis linking rubber and deforestation is therefore much needed, particularly when implementing the Forest Overseas Rule of Law and Environmentally Sound Trade (FOREST) Act proposed in the United States (US), the Environment Act adopted in the United Kingdom (UK) in 2021, and the European Union's (EU) regulations on deforestation-free supply chains (EU 2023a) and on Corporate Sustainability Due Diligence Directive (EU 2023b).

The rubber sector faces other important legality issues. For one thing, the scope and production of rubber by smallholder rubber is largely underreported, as is the volume of coagulated latex informally exported across the border to Vietnam. From 2003 to 2022, this export of coagulum was at odds with the 2003 ban on the export of unprocessed rubber (RGC 2003). In 2022, after a realization that this ban was not realistic and practical for the rubber sector, the government repealed the export ban officially to give options to smallholder rubber farmers and allow them to increase their profit (RGC, 2022). This change in the legal framework notwithstanding, the export of unprocessed rubber implies that domestic processing units have a difficult time sourcing latex to run at full capacity. Here, again, the economic losses are substantial in terms of value added creation and job creation.

RECOMMENDATIONS

These research findings, together with discussions held during the consultation workshop, allowed us to formulate several recommendations for different stakeholder groups with different time frame and level of complexity. Some key actionable next steps in the short term are:

For government

General Directorate of Rubber

- Support the development of an efficient collection system for latex to incentivize the export of rubber in forms other than coagulum
- Monitor tree cover loss, deforestation, and forest degradation, with a focus on identifying both direct and indirect drivers (government and research-based organizations)

Ministry of Land Management and Ministry of Environment

- Grant titles for rubber areas that remain untitled after Order 01, while making the titling process simple and accessible for landholders with limited resources

Ministry of Economy and Finance

- If export tax is maintained, use part of this revenue to support smallholder rubber farmers

For rubber cooperatives and development banks

- Provide and monitor access to credit with a low-interest rate for cooperatives, for example to proceed with quick payment to members

For large rubber estates

- Develop partnerships with smallholder rubber farmers (e.g., nucleus estates and rubber out-grower schemes)

For researchers

- Explore better management of soil fertility and the sustainability of on-farm coagulation practices using formic or sulfuric acid
- Promote tree species intercropping in rubber plantations and provide licenses for timber commercialization (government, smallholders, companies and research-based organizations should also be partners)

1 Introduction

In Cambodia, the production of rubber plays a strategic role in the agricultural development of the country (MAFF 2018), impacting land use and employment as well as the overall export-orientation of the country's agro-industry. While more land for rubber production has been allocated to privatized state-owned rubber estates (SOREs) and Economic Land Concessions (ELCs), smallholder rubber households have been more prolific in the actual planting of rubber trees. According to official government estimates, they have become major producers of natural rubber, accounting for nearly 40 percent of the total planted area in the Kingdom (MAFF 2018).

The Royal Government of Cambodia, and particularly the Ministry of Agriculture, Forestry and Fisheries (MAFF), has prioritized smallholder rubber production as a key contribution to the National Strategic Development Plan. The ministry considers smallholder rubber farming a way to add value to raw commodity production and create job opportunities, and thus contribute to rural poverty alleviation (RGC 2019; p. 199).

It is widely acknowledged, however, that Cambodia's rubber expansion was one of several drivers of rapid deforestation during the 2000s and 2010s. Cambodia lost almost 2.5 million hectares (ha) of tree cover between 2001 to 2020, a 28 percent loss in tree cover since 2000. The annual rate of loss increased by more than 400 percent over the same period with nearly 150,000 ha of loss occurring in 2020 alone, of which nearly half (43 percent) was in natural forests. Multiple studies also point to a high risk of this deforestation having been illegal, as defined as out of compliance with Cambodia's laws and regulations (Forest Trends 2021).

A "bust" occurred after a mid-2011 price spike, following more than a decade of "boom" in mainland Southeast Asia, mainly driven by soaring demand from China and Vietnam. As of mid-2022, the rubber market price in Southeast Asia has recovered slightly from this initial "bust" but has remained significantly and steadily below its peak (Figure 1).

Figure 1. Global rubber prices, 1997–2022

Source: Singapore Commodity Exchange (SICOM). Available at https://www.indexmundi.com/commodities/?commodity=rubber

Recent studies in the Mekong countries have shown that rapid rubber plantation expansion and associated deforestation has largely subsided in response to this bust cycle. With this drastic slowdown there has been a corresponding suspension in rubber acting as a primary driver of deforestation, with some variability between landscapes. Following the rubber market bust, new drivers of deforestation and land-use change have emerged. Yet no study has examined how the rubber market downturn of the last decade has affected the dynamics of smallholder rubber farming. It is crucial to answer these questions to understand the constraints faced by smallholder rubber farmers and to identify appropriate support strategies. It is equally important to understand the current drivers of deforestation in landscapes dominated by smallholder farms, many of which — outside countries where one commercial crop dominates, such as palm oil in much of Indonesia — produce a diverse array of commodities.

These deserve more research and a better-informed shift in advocacy approaches to ensure sustainable rubber production as well as other emerging commodity drivers of deforestation. Regional and global buyers need better data and analysis on these land-use dynamics and on legal, policy, and regulatory frameworks to conduct due diligence and support good governance throughout the supply chain more accurately.

This report contains the findings of a field-based research project in three smallholder rubber hotspots in Cambodia. The aim was to examine the agrarian transformations that have unfolded since the rubber market downturn, with a focus on three distinct research topics:

1. Land cover/land-use change and forest management at the landscape level, and resulting tree cover loss;
2. Rubber production economics and labor regimes at the household level; and
3. Structure and function of smallholder rubber within the wider rubber value chains.

This report is organized to address these three research topics. It first examines the pathways of land cover and land-use changes over the last 20 years in the study rubber landscapes, and the role that smallholder rubber farmers have played in these transformations. Having identified rubber as both a direct and indirect driver of land-use change, the report then analyzes agrarian change at the household level by looking at differentiation in land access, production economics, and livelihood adaptations. Finally, the report analyses the wider impact on the value chain. Recommendations are provided for multiple stakeholders involved in developing and promoting smallholder rubber production, processing, and trade, as well as implications for nascent demand-side measures to curb imports of forest-risk commodities linked to legal and illegal deforestation and the proliferation of zero-deforestation policies in downstream rubber companies.

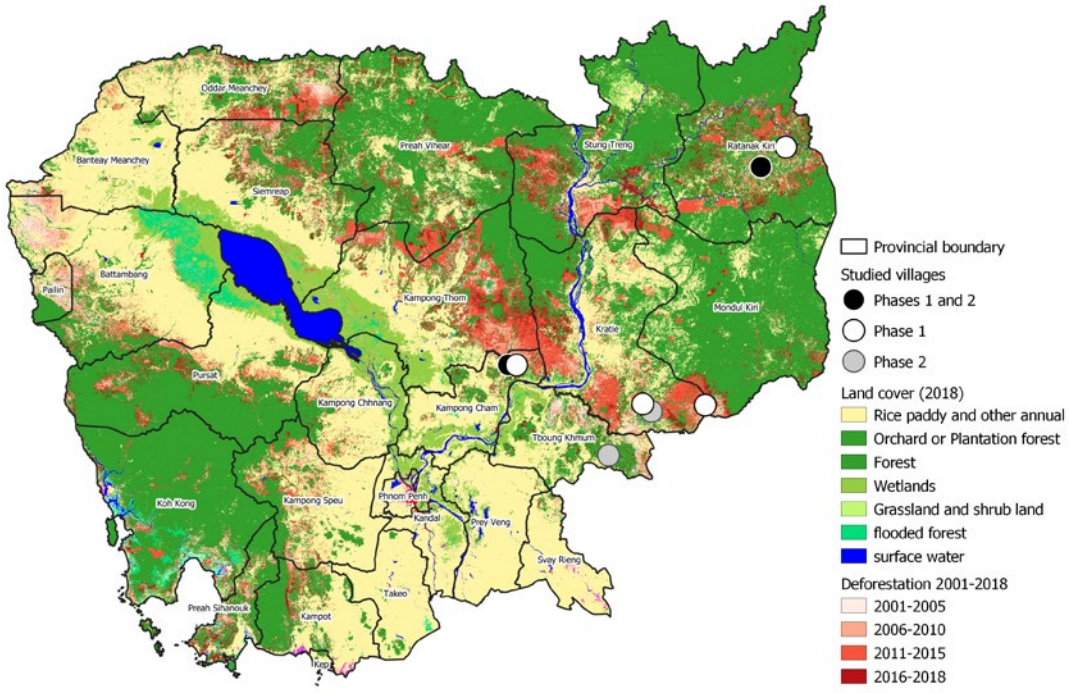
2 Methodology and Partnerships[1]

We conducted fieldwork in two phases: the first examined land use and livelihoods, and the second analyzed socio-institutional and economic aspects of the value chain.

Field studies were conducted in six villages located in three districts considered to be smallholder rubber hotspots (Map 1 and Table 1). They were selected for their history of significant rubber production and for being site of recent agricultural commodity-driven deforestation.

Information on the field sites was gathered from the research team's prior knowledge, plus a review of secondary data and literature, GIS analyses to identify rubber production and related land-use change, and consultation with Cambodia's General Directorate of Rubber (GDR), the Provincial Department of Agriculture, Forestry and Fisheries (PDAFF), and local authorities. Final selections include Stueng Trang in Kampong Cham, Snuol in Kratie, and Bar Khaev in Ratanak Kiri. In each district, we selected two communes and eventually one village per commune to capture a diversity of contexts.

Map 1. The study area and simplified land cover, as of 2018



Sources: Land Cover (SERVIR) Deforestation (Hansen et al.)
Data computation and mapping: authors

[1] While this project was conceptualized in 2019, fieldwork was delayed and complicated by COVID-19 pandemic restrictions beginning in 2020, so focus group discussions were purposely limited to approximately five people per group.

Table 1. Study area in Phases 1 and 2

Province	District	Commune	Village	Phase 1	Phase 2
Kampong Cham	Stueng Trang	Ou Mlu	Ktouy 2	☑	☑
		Areak Thnaot	Kilo 10	☑	
Tbong Khum	Memot	Dar	Samraong Cheung		☑
Kratie	Snuol	Snuol	Krasang	☑	
			Thpong		☑
		Kragnougn San Chey	Kragnougn San Chey Chheung	☑	
Ratanak Kiri	Bar Kaev	Lung Khung	Lung Khung	☑	☑
		Keh Chong	Krieng	☑	

2.1 PHASE 1: LAND USE AND LIVELIHOODS (MARCH AND AUGUST 2020)

In each selected province, we started with key informant interviews at the provincial and commune levels (n=11) to understand the wider dynamic of land cover and land-use changes, including rubber development. We also aimed to understand the role that smallholder rubber farming has played in this evolution. At the village level, we organized focus group discussions (n=6) to understand the development of rubber within the agrarian history of the location, the impact of the rise and fall of rubber prices, and the characterization of the different rubber farming systems in the village. Further, we conducted household interviews (n=82) to acquire detailed information about household trajectories in the past 20 years, including the different strategies used to adapt to the fall in rubber prices. We also conducted a GPS "ground truth" survey (604 points) to inform the Land Use Land Cover (LULC) change remote sensing analysis carried out with Google Earth Engine through supervised classification of annual Landsat images (2000 to 2020).

2.2 PHASE 2: RUBBER VALUE CHAINS AND ECONOMIC VALUATION (MARCH 2021)

We revisited the same three districts to conduct fieldwork for the second phase and identified whom to meet and where, based on our knowledge of local rubber processing [Technically Specified Rubber (TSR) and Rubber Smoked Sheet (RSS)] and trade dynamics.

In Kampong Cham and Ratanak Kiri, we visited one of the two communes selected in Phase 1. While in Kratie, we chose to conduct interviews in an area with a more active smallholder rubber cooperative. We also added one location in Memot district (Tbong Khmum province), considered to be a major hotspot for rubber production and trade to Vietnam.

At each location, we started with focus group discussions (n=4) with participants who were knowledgeable about rubber at the local level to map the rubber value chain and examine changes over the past 20 years or so. During the same discussions, we also conducted a detailed economic evaluation of rubber production and interviewed the following stakeholders to discuss their perspectives on the rubber value chain, relationships with smallholder farmers, and constraints they face:

- Rubber cooperatives (n=4)
- Rubber collector/transporter (n=1)
- Managers/owners of RSS factories (n=5) and TSR factories (n=2)

2.3 PARTNERSHIP AND SUPPORT

The project team worked in close partnership with the General Directorate of Rubber (GDR) under the Cambodian Ministry of Agriculture, Forestry and Fisheries (MAFF) and in collaboration with specialized officers at the Provincial Department of Agriculture, Forestry and Fisheries of Kampong Cham, Kratie, and Ratanak Kiri provinces. The remote sensing analysis was conducted by a team at the National University of Singapore.

Phase 1 research findings were presented and discussed at a consultation workshop hosted by the GDR on 14 October 2020 with the participation of the farmers and local authorities involved in the study, GDR management and technical staff, and organizations and agencies supporting smallholder rubber production (n= 51). We conducted a roundtable discussion on 21 December 2021 at the GDR to discuss Phase 2 findings and analysis. Our draft report was subsequently revised to account for feedback collected during these two workshops.

Field research team, from left to right: KONG Rada, Jean-Christophe DIEPART and KOU Phally.

3 Background: The Rubber Sector in Cambodia[2]

3.1 RUBBER PRODUCTION

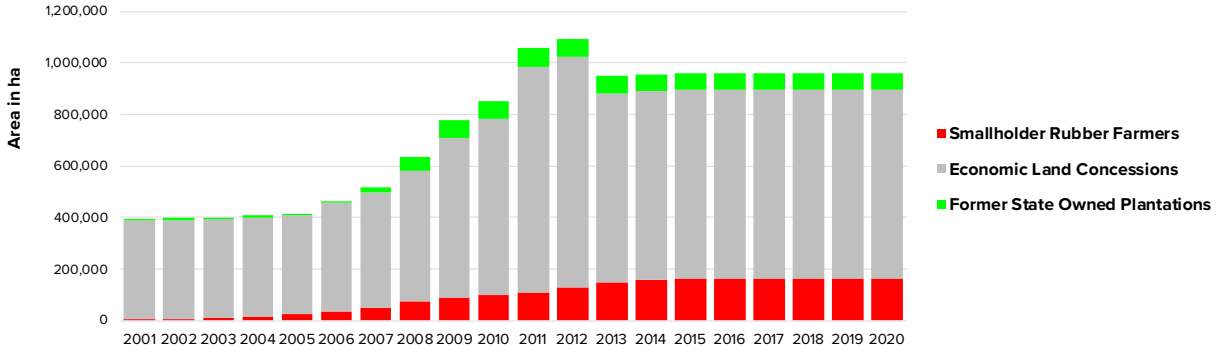
The Cambodian rubber sector consists of two main modes of production: smallholder rubber farmers[3] and large estates. The latter are composed of large-scale plantations registered as ELCs and former are State-owned Enterprises (SOEs) privatized between 2007 and 2010.

3.1.1 Land granted or acquired for rubber production

From the late 1990s through 2012, the Cambodian government granted ELCs for rubber and other agricultural commodities. The 2001 land law codified the legal justification for these large-scale concessions. The number of ELCs rose significantly from 2007 to 2011 due to a conjunction of political-economic factors, including soaring rubber prices, but ELCs were frequently the source of conflict, human rights abuses, and deforestation (Open Development Cambodia 2015). In 2012, Order 01 initiated by the government to improve ELC management across the country resulted in suspension of some existing ELCs, a review of existing concessions, and a moratorium on new ELCs.

As of 2020, 76 percent (735,000 ha) of the land area designated for rubber production had been granted as ELCs, 17 percent (161,000 ha) as smallholdings, and 7 percent (66,000 ha) as former SOEs (private estates). However, the area of smallholder rubber is underestimated in official statistics due to a lack of resources to collect and update the data, combined with underreporting by smallholder farmers themselves. Figure 2 and Map 2 below detail the size (in ha) and distribution (across the country) of rubber production.

Figure 2. Cumulated area of land granted/acquired for rubber plantations (2001–2020)

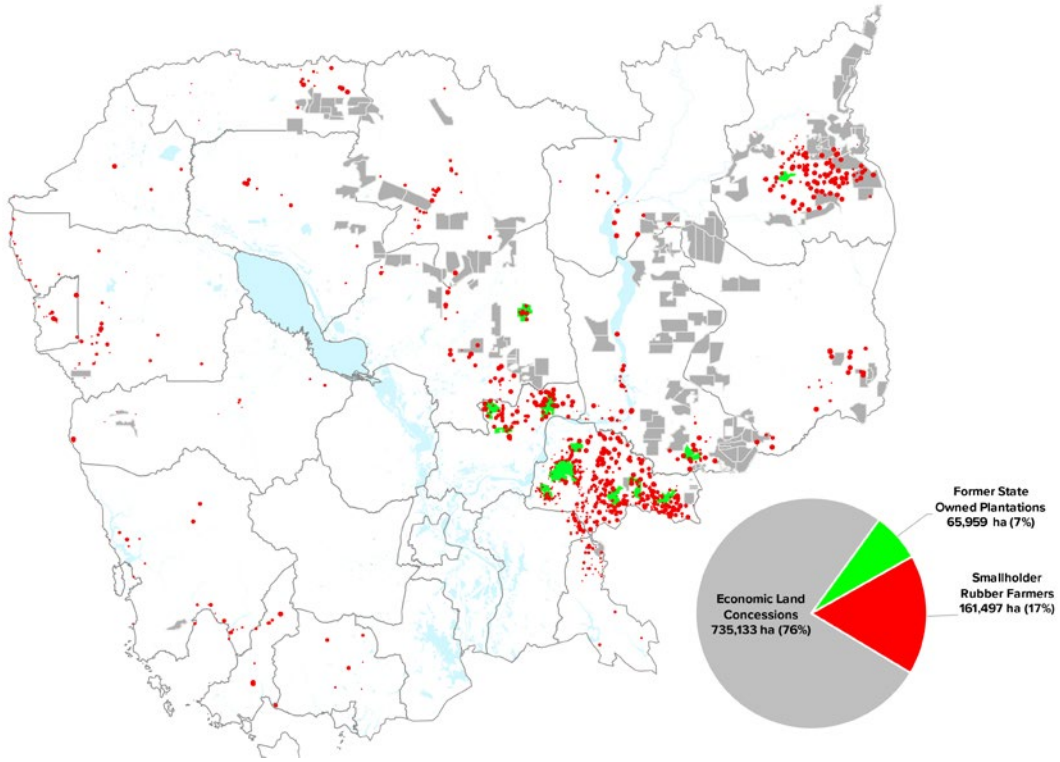


Sources: Smallholder Rubber (GDR 2021), ELC-Former SOEs (adapted from Open Development Cambodia (ODC))
Data computation: authors

[2] In this report, we present statistics updated to 2020. However, data computed by GDR for the years 2018–2019 and 2020 are not fully reliable because the data collection was underfunded during these years.

[3] "Smallholder rubber households" is a category by default that includes individual or family plantations that are not integrated into a former State-owned rubber enterprise or into an Economic Land Concession less than 45 ha (Law on Rubber (Draft)).

Map 2. Distribution of rubber plantations in Cambodia, as of 2020

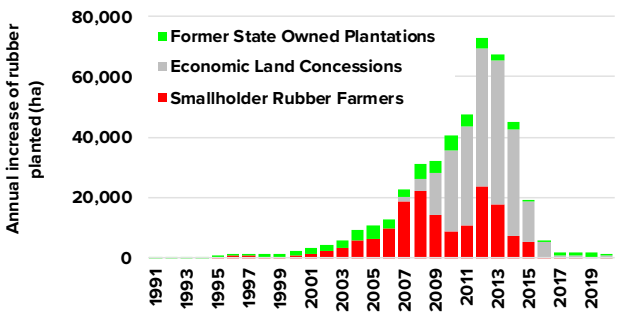


Source: Smallholder Rubber (GDR 2021), ELC-Former SOEs (adapted from ODC).
Mapping: authors

3.1.2 Land planted with rubber

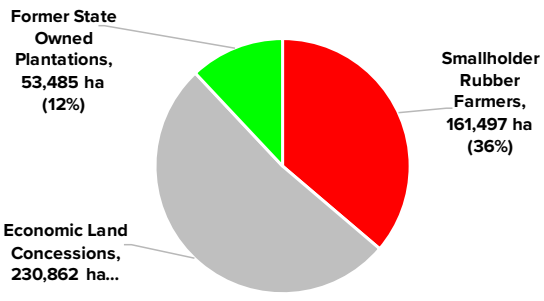
The actual rate of rubber planting has logically paralleled the increased in land allocated for rubber production: a sharp increase from 2007 to 2012 (Figure 3); however, not all land granted to ELCs for rubber has actually been planted. In fact, a higher percentage of smallholders planted rubber than the ELCs. As of 2020, smallholdings, covering only 17 percent of the land area designated for rubber production, represented 36 percent of the total rubber area actually planted in the country, while ELCs represented 52 percent (Figure 4). This highlights the strategic importance of smallholder rubber farming for the entire sector in Cambodia, even considering the previously mentioned underestimate of smallholder farmers' contributions.

Figure 3. Annual Increase of planted area of rubber, 1991–2020



Data computation: authors

Figure 4. Total area of rubber planted, 1991 to 2020

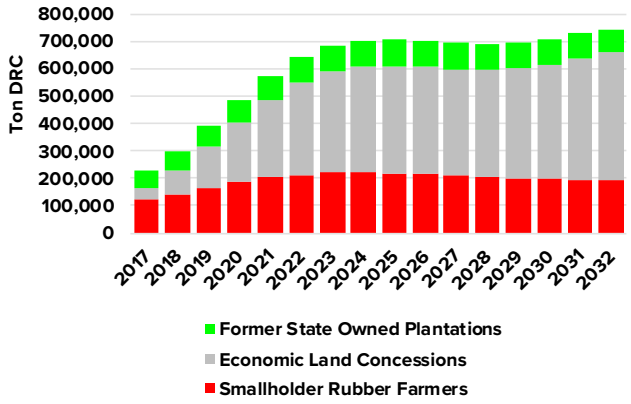


Data computation: authors

3.1.3 Rubber production

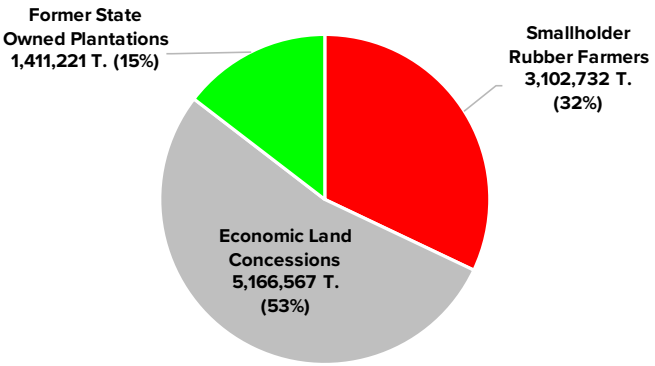
When factoring in the age of rubber trees and a typical production curve, it is possible to predict future production trends. Figure 5 projects the total production of rubber (tons of dry rubber content) from 2017 to 2032. Even if the bulk of production is in ELCs, the contribution of smallholder rubber production is far from insignificant (Figure 6), even more so when it can be assumed that its actual contribution is undercounted in official statistics.

Figure 5. Annual projected production, 2017–2032



Sources: Adapted from GLG-CIRAD 2018

Figure 6. Share of total cumulative production, 2017–2032

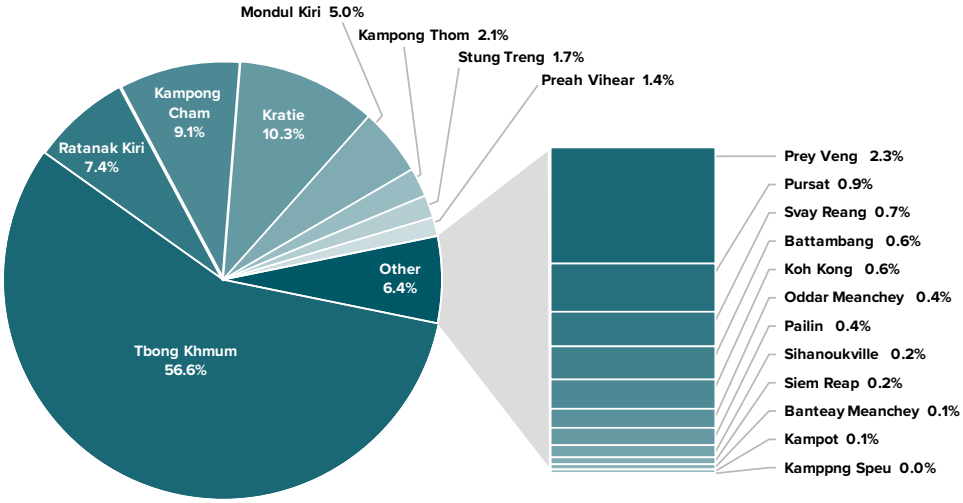


Sources: Adapted from GLG-CIRAD 2018

3.1.4 Smallholder rubber farmers

According to GDR official statistics, 32,100 households were cultivating a total area of 161,103 ha of rubber in 2019, with an average rubber landholding of 5 ha per household (see Annex). Fifty-six percent of all smallholder rubber farmers live in Tbong Khmum province. On average, in 2019, they owned 2.5 ha per household. Other key provinces for rubber production are Ratanak Kiri, Kampong Cham, and Kratie (Figure 7).

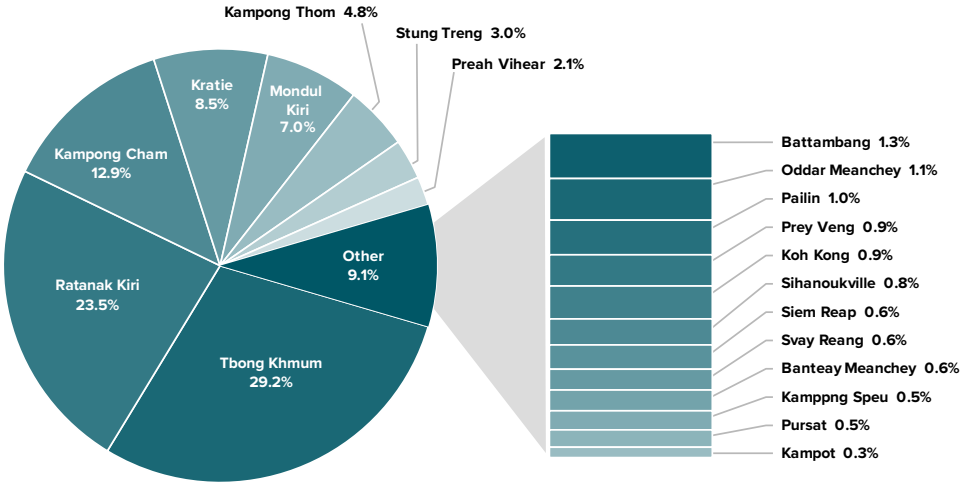
Figure 7. Distribution of smallholder rubber farmers in Cambodia, as of 2019



Sources: Smallholder Rubber (GDR 2021), ELC-Former SOEs (adapted from Open Development Cambodia (ODC))
Data computation: authors

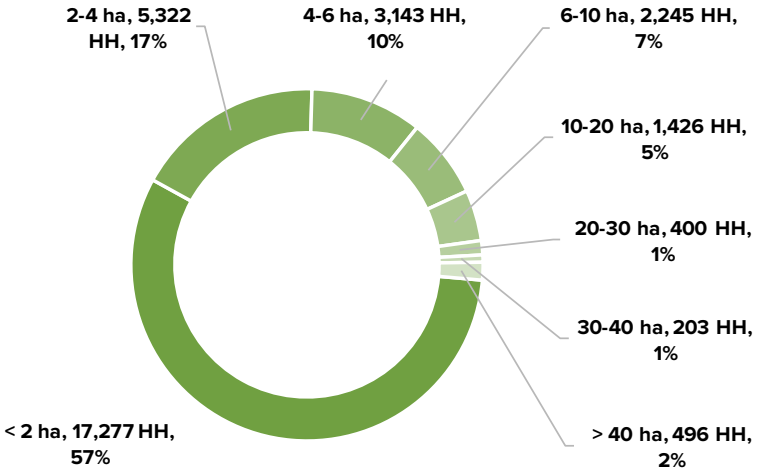
The area of rubber landholding owned by smallholder rubber farmers follows a similar distribution (Figure 8). The notable difference is Ratanak Kiri province, where the average rubber landholding is much larger than average at 16 ha per household.

Figure 8. Distribution of the total area of the rubber landholding of smallholder rubber farmers in Cambodia, as of 2019



There is also a skewed distribution of rubber landholding areas, even within the category of "smallholder farmers." Across Cambodia, 57 percent of smallholders have a rubber landholding smaller than 2 ha. Another 27 percent range from 2–6 ha. Notably, 4 percent of smallholder rubber farmers have a landholding bigger than 20 ha. For these farmers, the term "smallholders" is a misnomer: they are entrepreneurs whose economic decision-making processes are quite different from those who hold only 2 ha (Figure 9).

Figure 9. Distribution of rubber landholding per class of area



Source: GDR 2017

3.2 THE RUBBER VALUE CHAIN IN CAMBODIA

3.2.1 Actors and marketing

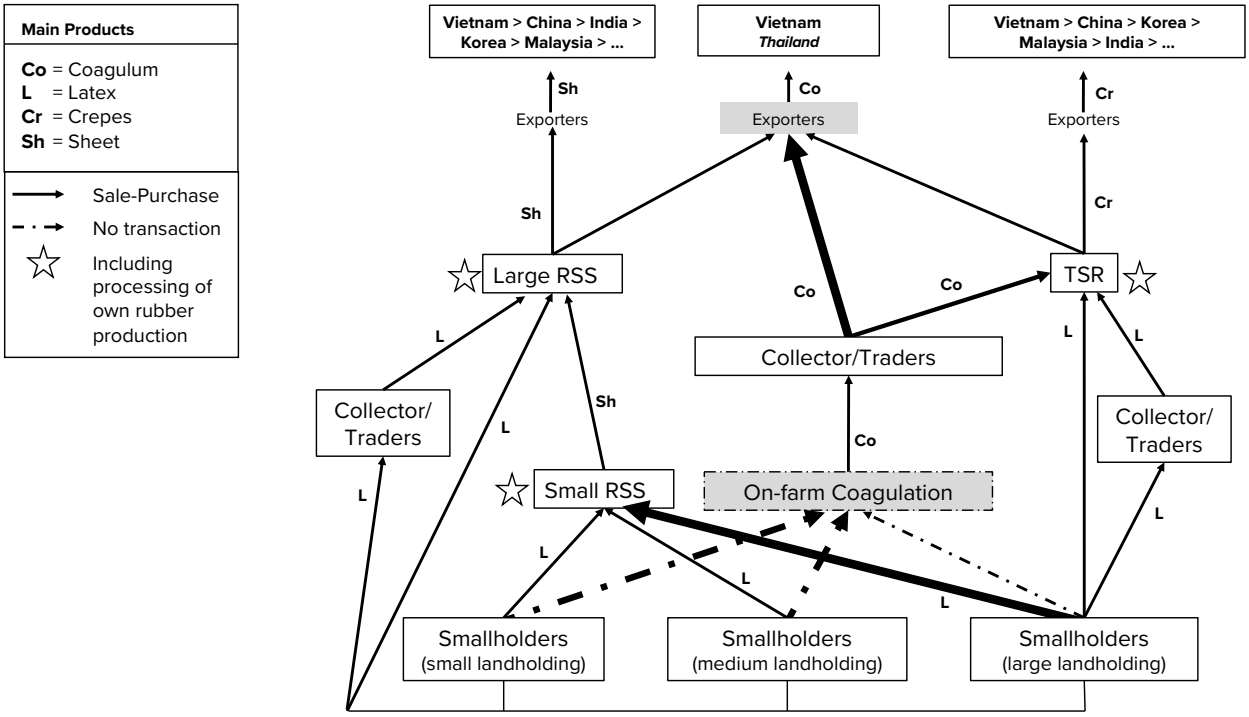
Two main methods are used to convert latex into processed rubber before export: conversion into RSS and conversion into TSR. RSS and TSR processors will usually utilize latex produced on their own plantations (Figure 10). The purchase of additional latex or coagulum from smallholder rubber farmers is contingent on the purchase price, the distance between the smallholder plantation and the processing unit, the availability of transport for latex (usually organized by the processing unit), or the accessibility of technical equipment to produce TSR from coagulum.

In 2016, there were 92 RSS processing units active in Cambodia, with total production capacity of 39,894 tons of Dry Rubber Content (DRC) per year. In 2016, the actual processing reached 20,250 tons of DRC, equivalent to 51 percent of total capacity (GDR 2017). Smallholder rubber farmers tend to sell their latex to an RSS unit if they live within a radius of 10 km (a distance that can be covered by motorbike within a day, as RSS units do not usually provide collection or transport services). Smallholders with larger rubber landholdings tend to sell directly to an RSS processing unit if they do not have one themselves. Large RSS units typically attached to larger plantations (former SOEs or ELCs) and usually export processed rubber directly. The main export markets for RSS are, in descending order: Vietnam, China, India, Republic of Korea and Malaysia, followed by a few other Asian countries.

RSS processing unit in Kampong Cham province

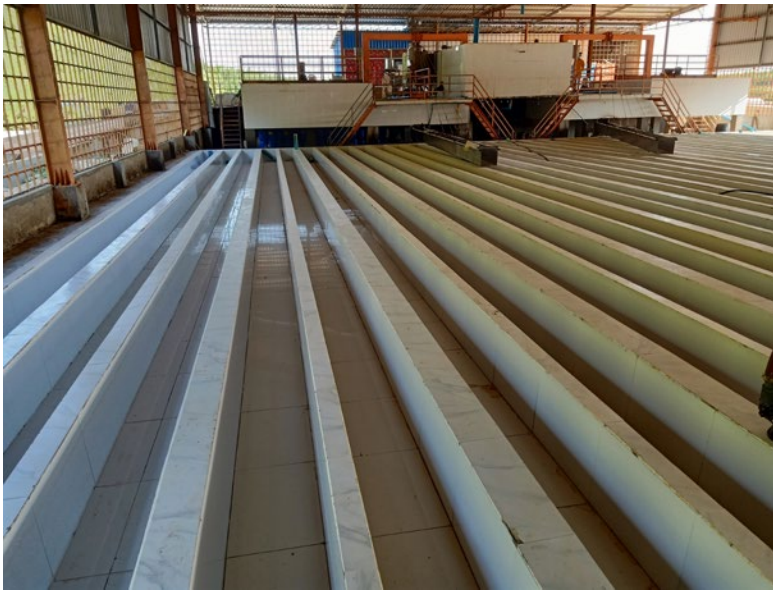
Credit: Kong Rada

Figure 10. Overall structure of the rubber value chain in Cambodia



Source: Authors, adapted from GLG-CIRAD

In 2016, there were 37 TSR processing units with a total production capacity of 211,500 tons of DRC per year. In that year, the actual processing reached 112,000 tons of DRC, equivalent to 53 percent capacity (GDR 2017). Most TSR processing units sourced latex from their own plantations, and some were also equipped to process coagulum. The main export markets for TSR are, in descending order, Vietnam, China, Republic of Korea, Malaysia, and India, followed by several Eastern European countries.



RSS processing unit in Kampong Cham province

Credit: J.C. Diepart

However, the bulk of latex tapped daily in Cambodia, particularly by smallholder rubber farmers who have only a small landholding, is not processed in RSS or TSR units; it is coagulated on-farm and sold to local collectors who take it directly to Vietnam (or, to a much lesser extent, to Thailand from Cambodia's northwest provinces). This is a central feature of the rubber value chain in Cambodia and is addressed in more detail in the Findings section.

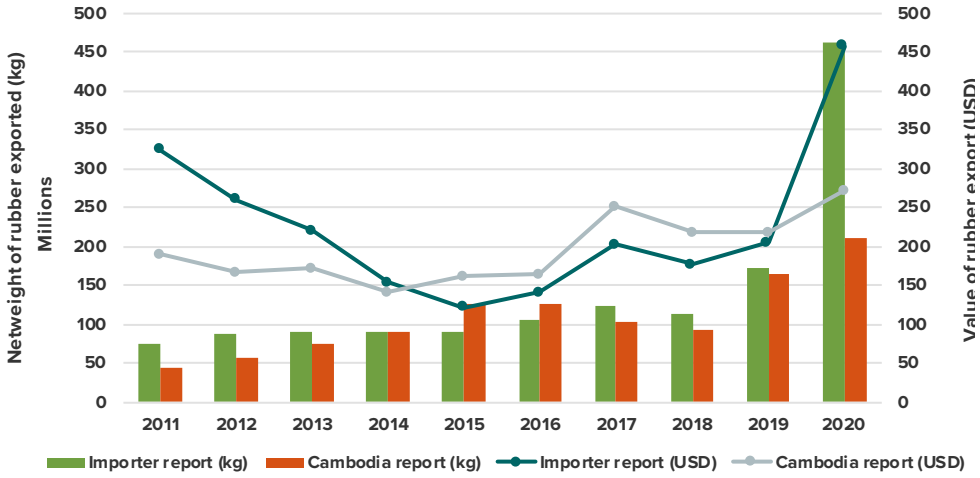
3.2.2 Exports

All Cambodian rubber is exported. It is difficult to precisely assess the quantity that is exported because a significant proportion is sold across the border to Vietnam without proper records.

Using Comtrade[4] data, Figure 11 shows the weight and value of Cambodia's rubber exports comparing Cambodia's reported export data with overseas markets' reported import data. Given the degree of informal, and potentially illegal, cross-border trade, the differences are significant. This section analyzes export data through 2020 as this is the period the study covers.

According to both Cambodian export data and mirror import data, the quantity of rubber exported has steadily increased over the last 10 years. This trend follows the increase in production. In monetary terms, however, export value declined between 2011 and 2015–2016, due to the drop in rubber prices in the global markets. After 2016, it swung back up due to the combined effect of production and price increases.

Figure 11. Evolution of quantity and value of natural rubber exports from Cambodia, 2011–2020

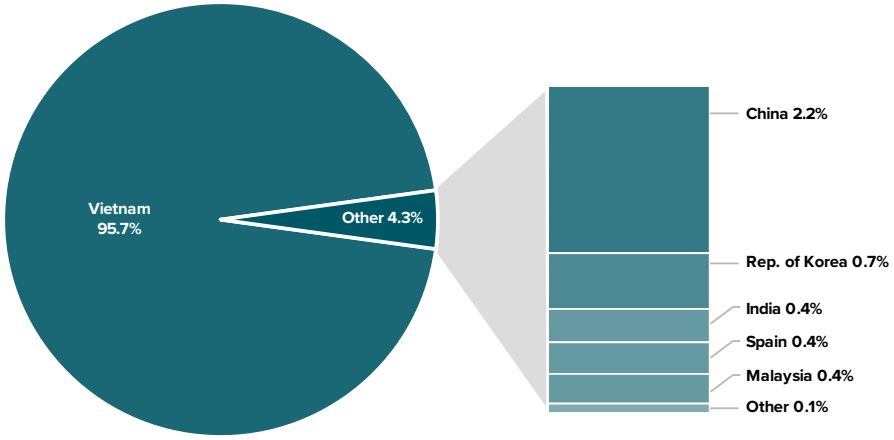


Source: Comtrade

In 2020, importing countries, particularly Vietnam, reported a sharp increase in the quantity of exports. This trend is consistent with production, considering that the large area planted with rubber in 2012–2013 is now of tapping age. Figure 12 illustrates that the vast majority of Cambodian rubber (nearly 96 percent) is exported to Vietnam. A large proportion of these exports consist of rubber coagulum, which was at odds with a 2003 regulation that bans the export of unprocessed rubber (RGC 2003) but was legalized in 2022.

[4] Database of the United Nations with exports and imports statistics by countries and tariff codes.

Figure 12. Distribution of rubber exports from Cambodia to different importing countries



Sources: Comtrade

Nearly all (98 percent) of Cambodian rubber exports, per import market data, are in the form of natural rubber. A small amount (roughly US$8 million in 2020) is processed within Cambodia into apparel and clothing accessories such as gloves; there are also additional, far smaller exports in the form of other rubber products.

4 Land Cover Change and Land-Use Pathways at Landscape Level

This section provides a land cover and land-use change analysis to contextualize rubber in the overall dynamic of land systems in Cambodia over the past two decades. We first map and quantify land cover change through a remote sensing analysis. Based on geosptatial imagery, we can demonstrate a more nuanced and complex picture as to why and how smallholder rubber farmers experienced various changes.

The area selected for the remote sensing analysis comprises a surface of 55,192 km^2, which was set arbitrarily across several provinces to include the three districts in our study area (Map 3). As such, it does not include the entire area designated for rubber use or planted with rubber in Cambodia, nor does it provide metrics for a specific province, district, or commune. Another caveat is that the analysis quantifies land cover changes between 2000 and 2020 but does not capture intervening changes (i.e., within years).

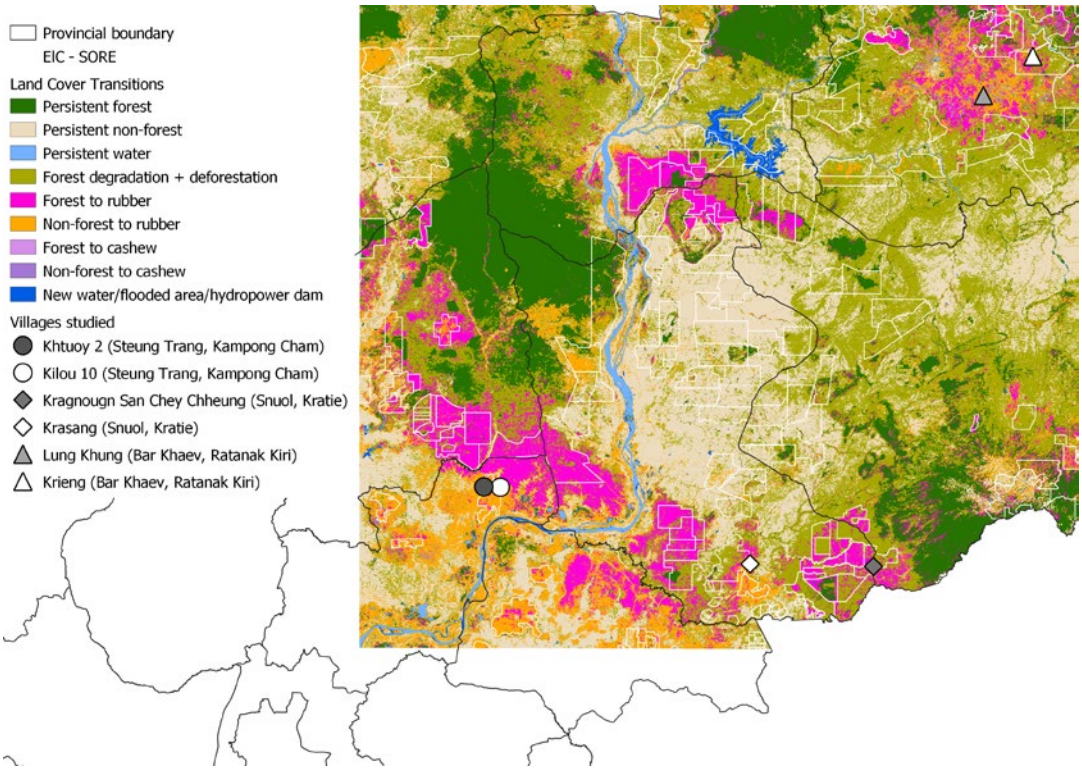
4.1 MORE THAN RUBBER: LAND COVER TRANSITIONS 2000–2020

Our analysis identifies the following major trends in Cambodia's land cover transition. While rubber is typically recognized as the key driver of land cover change and deforestation during the study period, our analysis shows a more complex picture:

1. We highlight intensive transformation in land systems over the period 2000–2020. More than half (56 percent) of land in the area studied, totaling 31,071 ha, has undergone a change in use at least once.
2. Deforestation and forest degradation account for 70 percent of this land cover change area, including the transition from forest cover to rubber production accounting for only 17 percent (Table 2). These findings confirm the results of similar thematic studies (such as Hurni and Fox 2018).
3. However, rubber-driven deforestation cannot be attributed to a particular mode of production. We can deduce only that a significant part of it took place inside land delineated as ELCs.
4. Rubber-driven deforestation has declined since 2013. In areas outside of ELCs, cashew has become a key "pioneer crop" (deforestation driver).
5. An even more significant area of rubber comes from the replacement of old rubber plantations established before 2000 in areas known for being the cradle of rubber in Cambodia, or from the conversion of other crops (e.g., cashew) to rubber.

Official GDR statistics suggest that, in 2020, the total area planted with rubber across Cambodia was 445,844 ha, comprising ELCs, former SOEs, and smallholder rubber plantations. However, our survey suggests that the actual area is much more significant: 1.17 million ha in our study area alone. As accurate data are crucial to inform policies that frame the production, processing, and trade of natural rubber, this important discrepancy underlies the need for more reliable and inexpensive remote sensing methods to collect and update rubber production statistics.

Map 3. Land cover change map of the studied area, 2000–2020



Data source: Landsat images

Table 2. Computation of land cover change in the study area, 2000–2020

	Area (km^2)	% of Total	% in Section	User Accuracy	Producer Accuracy	F1-Statistic
Section A. No Land Cover Change						
Persistent forest	8,968	16.2%	37.2%	0.8929	0.8929	0.8929
Persistent non-forest	14,422	26.1%	59.8%	0.8049	0.8115	0.8082
Persistent water	730	1.3%	3.0%	1.0000	0.9211	0.9589
Total area with no land cover change	**24.120**	**43.7%**	**100%**			
Section B. Land Cover Change						
Forest to rubber	5,397	9.8%	17.4%	0.8333	0.9351	0.8813
Forest to cashew	37	0.1%	0.2%	0.8727	0.7869	0.8276
Forest degradation and transition to non-rubber and non-cashew tree crops	18,738	33.9%	60.3%	0.7784	0.7423	0.7599

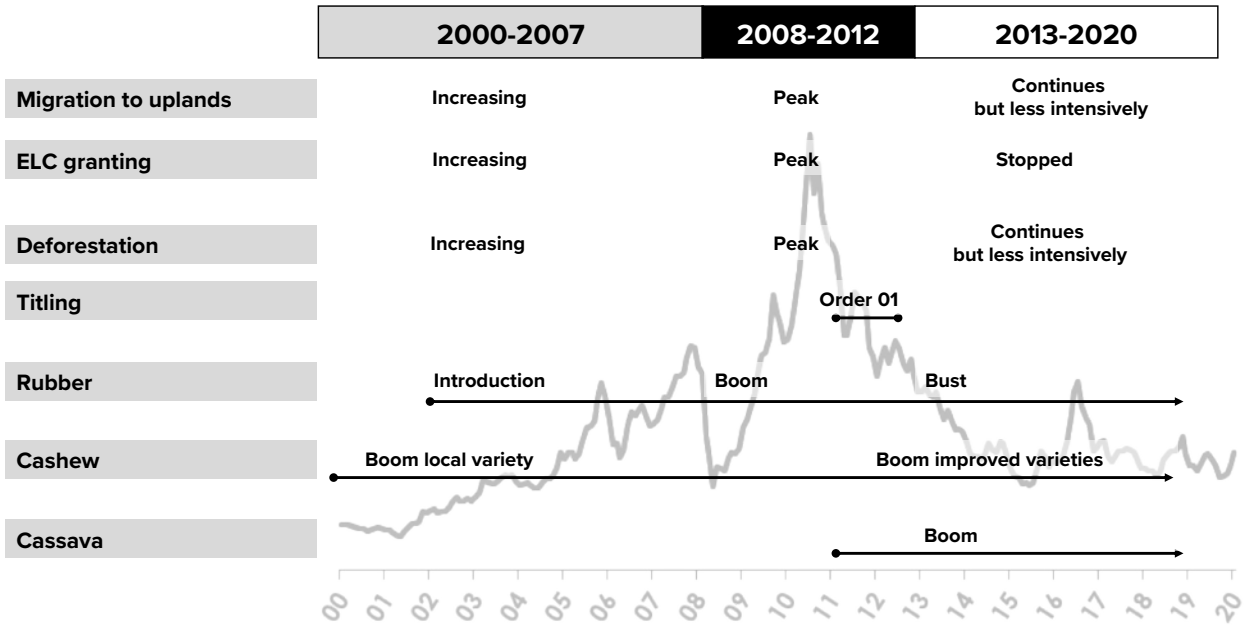
	Area (km^2)	% of Total	% in Section	User Accuracy	Producer Accuracy	F1-Statistic
Non-forest to rubber	6,339	11.5%	20.4%	0.8881	0.8344	0.8604
Non-forest to cashew	165	0.3%	0.5%	0.9351	0.8090	0.8675
New water	395	0.7%	1.2%	0.9726	0.9861	0.9793
Total area with land cover change	**31,071**	**56.3%**	**100%**	**Overall accuracy: 0.8568**		

Data source: Landsat images

4.2 MORE THAN THE PRICE: DRIVERS OF LAND-USE CHANGE

The transformation of land cover and land use related to rubber is caused by multiple interacting factors that operate at local, national, or global levels. The rubber price is an initial direct driver of land-use change, but it is by no means the only one. Its role and influence are mediated by several other variables that pertain to either the social or biophysical dimension of the land systems in these rubber landscapes: the market dynamics of rubber and other crops; migration of smallholder farmers to upland areas; ELC implementation; land titling; soil quality; and the existence of a forest frontier. The relative importance of each of these variables changes over time. To make sense of this temporal dimension, we identify three periods, each characterized by specific interactions between drivers: 2000–2007, 2008–2012 (the "rubber boom"), and 2013–2020 (Figure 13).

Figure 13. Main drivers of land-use change in rubber landscapes and their temporality, 2000–2020



Note: The graph underneath shows the evolution of rubber prices (Ribbed Smoked Sheet) for the period 2000–2020

4.2.1 Commodity markets

It is widely acknowledged that the global rubber price is significant in shaping the smallholder rubber sector. Previous research has established a robust link between the rubber price and the expansion of rubber planted areas between 2001 and 2015 (Grogan et al. 2018). However, rubber is one commodity among others at landscape and household levels; rubber landscapes are not monolithic and should be understood in the context of multiple uses. The economy of smallholder farmers involved in natural rubber production — and their related on- and off-farm activities — is thus influenced by other commodity cycles. Since 2013, (concomitantly with the rubber price bust) cassava, cashew, and pepper have become important commodities in the study area. The upfront investment to establish a cashew plantation and maintenance costs during the vegetative stage is much lower than for rubber. Cashew is thus a preferred pioneer crop for farmers with unclear land tenure or with lower investment capital.

4.2.2 Migration

Important migration movements driven by the search for agricultural land have relocated many smallholder farmers in upland areas across the country (Diepart and Ngin 2020). In Kratie and Ratanak Kiri, we came across many smallholder rubber farmers who were originally from Kampong Cham or Tbong Khmum provinces, which are known as the cradle of rubber development in Cambodia. When they resettle, migrants bring knowledge and connections with rubber trade networks, which creates links between old and new rubber production areas. This agrarian expansion unfolds at the expense of forest cover. Both factors are spatially and temporally correlated: they steadily increased up to 2008 and peaked around 2011–2012. In areas with an open forest frontier where farmers could settle, migration continued, albeit less intensively. In areas without the possibility of expansion into standing forests or conversion of land from other uses to rubber, smallholder farmers are now driven by the search for a job, or they seek to purchase or convert established small-scale plantations.

4.2.3 Economic land concessions

The granting of ELCs started at the end of the 1990s and was in full swing between 2008 and 2012 when Order 01 came into effect. The degree to which the granting of a concession has translated into actual planting of the designated crop depended on the ELC's financial capacity and the negotiations between companies and smallholder farmers living in the ELC area — a relationship that often resulted in conflict. In all cases, however, the establishment of ELCs has had transformative effects on the entire agrarian landscape of Cambodia with considerable impact on the development of smallholder rubber (Open Development Cambodia 2015). NGO reports note that ELCs designated for infrastructure and commercial agriculture projects allow "pseudo-legal timber extraction, saw-milling, and wood transportation" as well as "the laundering of illegally harvested timber in equal, if not greater, proportions." Using the ELC system as a tool for timber harvesting in natural forests is rampant but considered illegal. Corruption is reportedly a concern in the allocation of ELCs (Forest Trends 2021).

4.2.4 Land tenure security

Rubber development is resource-intensive, meaning land users with secure tenure are more likely to invest in rubber production. In upland regions favorable to rubber development, the formalization of land rights was almost non-existent until the land titling campaign conducted in 2012–2013 as part of Order 01, which

was intended to address conflicts between ELCs and smallholder farmers. Although this initiative was short-lived and ended with many areas still untitled, the degree of tenure security conferred by formal title has incentivized the conversion of established plantations into rubber by smallholders. In other cases, landholders would opportunistically clear forests to claim de facto land rights before planting rubber, which was seen as a more "productive" land use than shifting cultivation, cultivation of non-timber forest products, or maintenance of small forest estates.

4.2.5 Biophysical environment

Rubber can only be planted in certain agro-ecological environments and depends, in large part, on the edaphic (e.g., soil) conditions of a particular landscape. The study area is well suited for rubber production in terms of temperature, sunlight, moisture, and annual rainfall. Soils known by farmers as red soils (Ferralsols) and black soils (Cambisols) with an elevation of 150–200 meters above sea level, a preferably less than 20-degree slope, and a deep soil profile of at least 1 meter, are the best suited for rubber. Rubber production is difficult and thus economically riskier on white soils (Acrisols).

4.3 PATHWAYS OF LAND-USE CHANGE

The actual land-use changes on the ground are the contingent outcomes of interactions between multiple drivers. This section identifies three distinct pathways of land-use transition related to smallholder rubber in Cambodia.

4.3.1 Development of smallholder rubber in forest pioneering driven by migrants

When smallholder farmers are the key agents of agrarian change, our data show that they will develop rubber plantations on the forest frontier.[5] ELCs might be involved but they are not the dominant actor, either because they perform poorly or because farmers managed to defend and sustain their claim on land (often a combination of both). The dynamic of smallholders increased gradually up to 2008 and intensified subsequently in conjunction with the rubber price increase and migration-fueled deforestation (Figure 14).

The pioneer crop was often cashew; as mentioned above, rubber was rarer due to tenure insecurity. The land titling campaign conducted under Order 01 in 2012–2013, coinciding with the peak in rubber prices, provided strong incentives to convert cashew into rubber plantation and to clear additional land to establish new rubber crops. The expansion was often fueled by people clearing forest, selling land, and then moving further into the forest. The most suitable soil for rubber was cleared by the time of the titling campaign. In sum, a combination of more secure land tenure when rubber prices were high, and appropriate biophysical conditions, incentivized smallholder rubber production.

Starting in 2013, migration continued, albeit less intensively. If the forest frontier was still open (within or outside of the village area) and either the soil was unsuitable for rubber or smallholders lacked title — or both — cashew was planted as a pioneer crop. If the forest frontier is closed (or there is no interest in clearing a long way out), smallholder farmers convert existing plantations to rubber, or purchase land from others, if they can afford it.

[5] As seen in Khtouy 2 and Kilo 10 villages in Stung Trang district, Kampong Cham province, and Krasang village, Snuol district, Kratie province.

Figure 14. Land-use change pathways: development of smallholder rubber in pioneer forest driven by migrant farmers

1. Development of smallholder rubber in forest pioneer driven by migrants			
	2000–2007 →	2008–2012 →	2013–2020 →
LAND ACQUISITION	Clearance or/and Krom Samaki	Clearance > purchase	Purchase > Clearance
		** Conflict with ELC but ELC fades out **	
SOIL	Best	Second best	Less suitable
PIONEER CROP	Cashew/Banana > Rubber	Cashew > Rubber	Cashew > Rubber
CROP CONVERSION		Cashew to rubber	Cashew to rubber

4.3.2 Development of smallholder rubber farming in landscapes transformed by Economic Land Concessions

In this scenario, migrants have initiated small-scale cashew plantations in an area that has been granted to a company under an ELC agreement.[6] Here, however, the ELC looms larger in the balance of power and plays a driving role in in transforming the landscape. During the Order 01 titling campaign, ELCs sought to maintain their territories and forced out all smallholder farmers living inside the concession (Figure 15). The typical advancement of the forest pioneer is thus truncated and prevents the creation of smallholder rubber production basins. Adding to the expulsion and the deprivation of land titles, the smallholder farmers are forced to move elsewhere and usually settle further afield in forests or protected areas and with less secure land tenure. In these new locations, the absence of title and the less favorable edaphic conditions mean that rubber production is usually a risky venture. Those who are not ready to make this risky move tend to return to their home regions and usually work as wage laborers in a large rubber plantation. The relatively better-off smallholders are those who acquired land outside the ELCs; they could keep this part of their agricultural landholding and take advantage of the favorable conjuncture (titling and high rubber price) to convert all or part of their cashew plantation into rubber. The bulk of deforestation visible on Map 3 concerns the forest area located inside the ELCs that was chopped down to clear the way for rubber plantation.

Figure 15. Land-use change pathways: development of smallholder rubber transformed by Economic Land Concessions

2. Development of smallholder rubber in region transformed by Economic Land Concessions			
	2000–2007 →	2008–2012 →	2013–2020 →
LAND ACQUISITION	Clearance	Clearance > purchase	Evicted farmers clear land in remote area
		** Conflict with ELC **	
SOIL	Best	Second best	Less suitable
PIONEER CROP	Cashew	Cashew	Cashew
CROP CONVERSION		Cashew to rubber	Cashew to rubber

[6] As seen in Kragnougn San Chey Cheung village, Snuol district, Kratie province.

4.3.3 Development of smallholder rubber farming in a shifting cultivation landscape

Smallholder rubber farming dynamics are slightly different for ethnic minority farmers who practice shifting cultivation.[7] Yet we observed similar trends of migration and agrarian expansion in these areas at the start of the 2000s. Cashew is usually the pioneer crop (Figure 16). The arrival of migrants who engage in permanent agriculture provides swiddeners both with fears about losing their swidden plots (under cultivation and fallow) and with an incentive to convert part of these into permanent agriculture. This resulted in a hybrid agricultural system consisting of both permanent and non-permanent crops. The complexity of land relations, as well as the management of this mosaic, works through a mix of collective and private arrangements. During titling activity in 2012–2013 under Order 01, no collective titles were offered for shifting cultivation plots, which further incentivized the conversion to permanent agriculture. And for the reason discussed above, the collective "title, rubber price, good soil" push for the expansion of smallholder rubber production, either through the conversion of pioneer cashew or through the direct conversion of swidden plots, took place. The dynamic is self-sustaining and results in further agrarian expansion into the forest, driven by both swiddeners and migrants.

Figure 16. Land-use change pathways: development of smallholder rubber plantations in transforming swidden agriculture landscapes

3. Development of smallholder rubber in shifting cultivation landscape

	2000–2007	2008–2012	2013–2020
LAND ACQUISITION	Privatization of swidden landscape ! Migrants: land purchase ! Indigenous peoples: conversion of fallow land	! Migrants: land purchase ! Indigenous peoples: conversion of fallow land	! Migrants: land purchase ! Indigenous peoples: clearance of reserved forest or land purchase in remote area
SOIL	Best	Second best	Less suitable
PIONEER CROP	Cashew	Cashew > Rubber	Cashew
CROP CONVERSION		Cashew to rubber	Cashew to rubber

[7] As seen in Tumpoun in Ratanak Kiri, and Stieng in Kratie and landscapes (both villages studied in Ratanak Kiri).

5 Agrarian Transformations at Smallholder Farmer Level

This section examines how the rubber price drop influenced the socio-economic differentiation between smallholder rubber farming systems and impacted their income and livelihoods, as well as their adaptation strategies to the decline of rubber price.

5.1 DIFFERENTIATION OF SMALLHOLDER RUBBER FARMING SYSTEMS

Smallholder rubber producers have both contributed to and been influenced by the land cover and land-use transformations discussed in the preceding section. Yet the mechanisms at play vary. We suggest that a clear understanding of socio-economic differentiation between smallholder rubber farmers is necessary to understand the different ways in which they have adapted to the economic downturn in the rubber sector.

5.1.1 Factors of differentiation between smallholder rubber farmers

This diversity of evolution at the household level is caused by multiple interacting factors that concern the timing of their installation — which has an important bearing on the size and type of land they can acquire — and their capacity to invest in rubber production. We identify three main factors of differentiation:

Time of arrival

For migrants, the time of settling in the village is critical. Often, early arrival is associated with advantages. It influences the mode of acquisition and the surface of the land that can be cleared. Until 2001–2002 and the release of the Land Law, acquisition of agricultural land was usually not monetized and essentially depended on labor capacity. An early migration also meant that farmers had multiple options and could choose the best land (soil fertility, access to water or road, etc.). A corollary of this is that later migrants have access to land located further from the village center, usually of lesser quality, with tenure that is less secure and where supervision is more difficult. We observed this center-periphery relationship in all six villages we studied. As a result, the household that secures access to suitable land, and started agricultural production at an early stage, had trees (cashew or rubber) in production when the price increased and were able to take full benefit of the boom phase. Rubber production was well underway in Stueng Trang before 2000. The households who were involved in rubber Krom Samaki[8] in the late 1980s could acquire rubber land and usually rubber trees of tapping age after the dissolution of the Krom Samaki. This has contributed to the availability of upfront investment capital for further expansion or purchase.

[8] Namely Solidarity Group. Krom Samaki were declared and recognised between 1979 and 1989 as the main unit of rural development. A Krom Samaki comprised a small group of 10–15 families who used the land, agricultural equipment, and draft animals collectively.

Upfront investment capital

Households that arrived later in the village were not equally equipped to purchase land. Those who had significant upfront capital (e.g., generated from another farm or from non-farm activities elsewhere), particularly those who could purchase land with rubber trees of tapping age, could bypass the land accumulation process of the early migrants. The economic asymmetry between some wealthy buyers and poor sellers explains the rapid socio-economic differentiation within communities. Those who lost out will increasingly depend on wage labor or will move to a place where land is cheaper. The mobility that unfolds is, therefore, an important consequence of these processes.

Land accumulation through inheritance

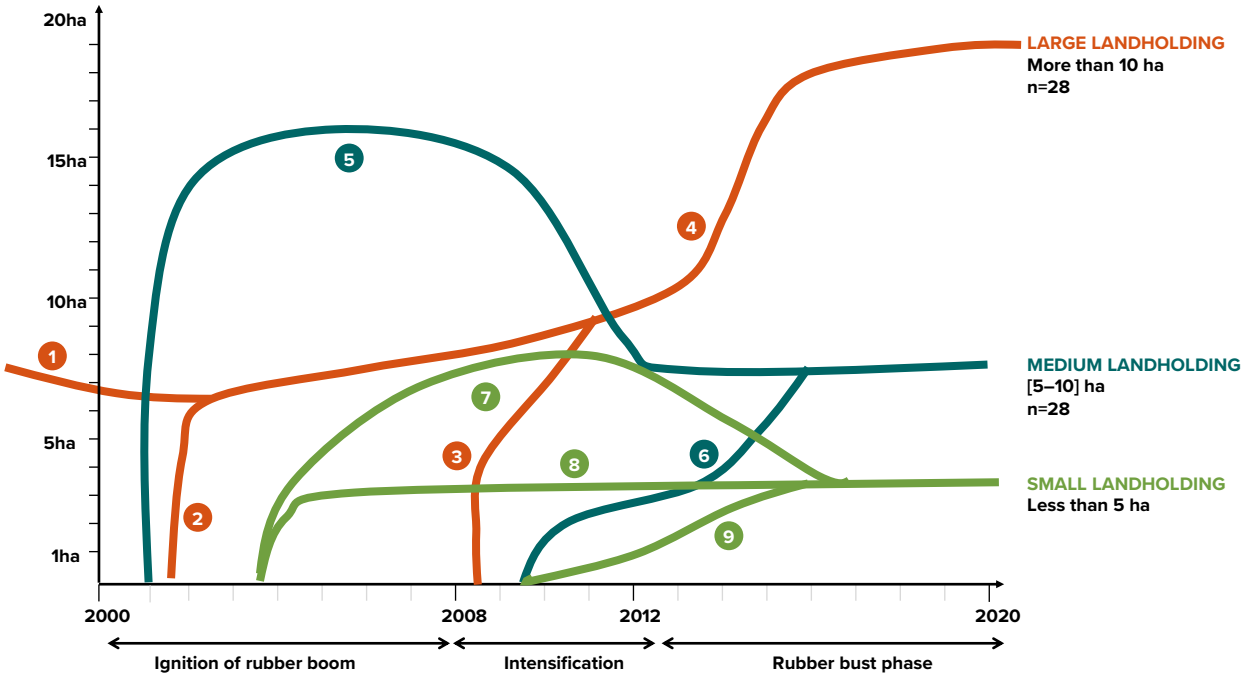
When the pioneer of a family has been established in the village for a long time, the transfer of land-based accumulated wealth through inheritance is highly relevant. This is particularly the case for households who inherit a rubber landholding from their parents and who can start an accumulation process quickly. This is key when the associated rubber trees were planted before 2005–2006, as these would have been at a productive stage at the time of the boom (2011–2013). Without this initial support, land accumulation is more constrained because it is mediated through market mechanisms.

5.1.2 Trajectories of change at household level

Despite the wide diversity of local contexts, the processes of socio-economic differentiation between households are relatively similar across the six villages. We captured a pattern that allows for the identification of three main categories or types of households based on the total size of their agricultural landholding. Each number within a circle in the following text refers to a corresponding point in Figure 17.

1. The group of smallholder rubber farmers with the largest landholdings (more than 10 ha) are either families engage in rubber Krom Samaki (①) or who are among the early migrants or swiddeners who started the conversion of the shifting cultivation plots at an early stage (②). They can also be later migrants who arrived with upfront capital and managed to access a large tract of land or have received land as an inheritance (③). The common feature of these households is that they had rubber trees of tapping age during the time when prices peaked (2008–2012), which gave them the financial means to expand their landholding through clearing land, although they usually purchased or acquired recently cleared land (④).
2. The second group with medium-sized landholdings are either households that arrived early but went through one cycle of expansion and transfer through inheritance (usually an older household head with limited labor availability) (⑤) or later migrants who accessed land through purchase or received it as an inheritance (⑥). Unlike the previous group, this group did not have the labor or financial resources to expand their landholding further in the wake of the rubber price boom.
3. The third group with small landholdings consists of households who arrived after 2001 and had to purchase their land with limited financial resources. As is the case for the previous group, the oldest among them had gone through a cycle of expansion and inheritance (⑦) while others had not managed to expand their agricultural landholding (no labor, no cash, or land expropriation by ELCs)(⑧). A third trajectory relates to later migrants who purchased without much upfront capital or inherited from poor parents (⑨).

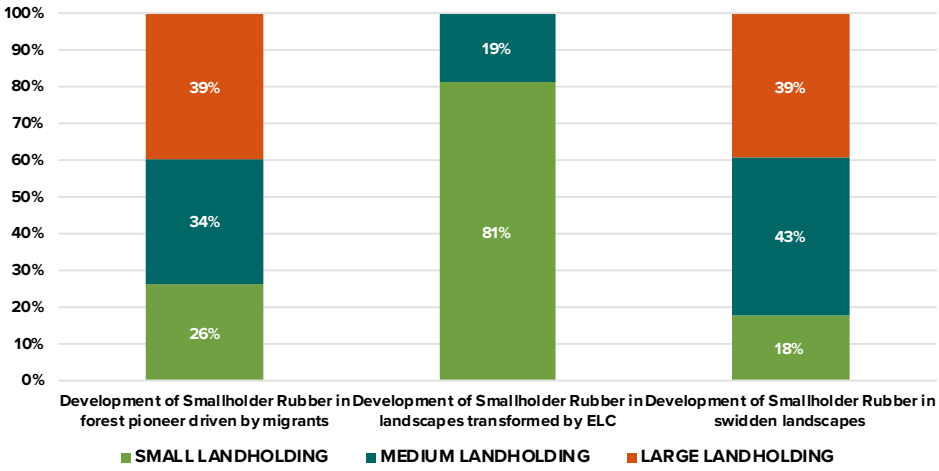
Figure 17. Differentiation in access to rubber land holdings among smallholder farmers



The rapidity with which this socio-economic differentiation process took place is striking. It is primarily due to the concomitant convergence of migration, rubber price, and titling. The differences between these groups are huge in terms of livelihood, ranging from households living in lavish villas, with big cars and children studying at universities in Phnom Penh, to families living in small shelters struggling to make ends meet. The general category of "smallholder rubber farmer" erroneously conveys the idea of a homogenous group when compared with ELCs. But, in fact, this categorization hides a large diversity of livelihoods and well-being.

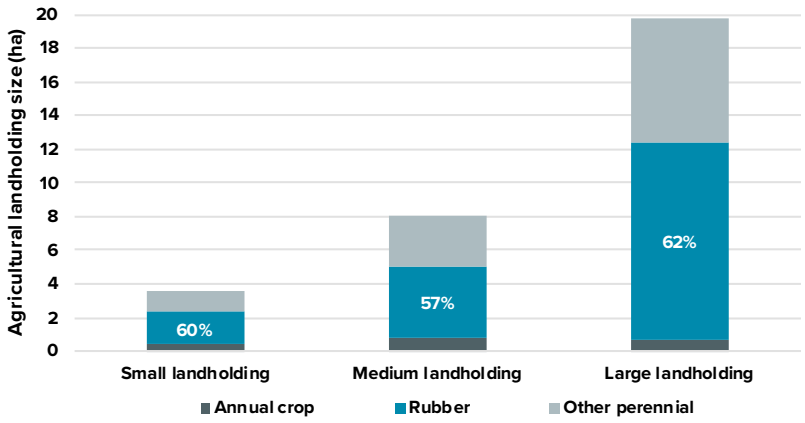
The three groups are represented in areas where smallholder rubber development is driven by migrants in forest pioneering or in swidden landscapes. However Figure 18 clearly demonstrates the impact of land expropriation due to ELCs and the truncated agrarian expansion.

Figure 18. Distribution of each SHR type in the three rubber landscapes studied



Rubber is one commodity among others and is part of diversified cropping systems along with annual and perennial crops (Figure 19). This was a consistent feature in the six villages. The rationale behind this is the need for farmers to manage varying land quality, land tenure security, and economic risk. In all three groups, rubber accounts for around 60 percent of the total cropping area. Other perennial crops are cashew or pepper, although the pepper market has collapsed and the overall crop has largely been diminishing. Annual crops are small but are given greater importance in the portfolio of farmers with small landholdings, as they usually provide income for farmers during the period when rubber is still immature. In medium and large rubber landholdings, annual crops are intercropped for only the first three years.

Figure 19. The variations in the cropping systems of each SHR type



5.2 EFFECT ON THE ECONOMICS OF PRODUCTION AT FARMING SYSTEM LEVEL

The objective of this section is to examine the variation in rubber production economics between districts, rubber landholding sizes, and rubber price (boom and bust phases).

5.2.1 Introducing the notion of value added and parameters of the economic modeling

The measurement of rubber production economics is based on notions of value added, which indicates the wealth created during the production process. The notion of value added is relevant because it allows for a comparison to be made between production sites and between rubber landholding sizes. It is the reason why all measures of Gross Value added (GVA) are calculated based on the same unit, namely value added per ton DRC of rubber produced, per hectare for the total plantation life time and per total area for the whole plantation.

The GVA equals the value of the gross product (production self-consumed, sold, given, or lost in post-harvest) minus the value of all Intermediate Inputs (II) used during the production cycle (Figure 20). It measures the wealth created by the farming family and the people working with them. For this reason, the wages paid to external workers, the land rent if a farmer leases it, the taxes paid to the State and the interest rate paid to credit institutions should not be counted as Intermediate Inputs because they determine how the wealth is distributed, not how much wealth is created.

We also take into account all cropping activities associated with rubber during the immature phase (i.e., the inter-cropping that takes place in-between lines of rubber trees during the first three years of production). All the parameters used for the economic calculation are presented in Table 3.

Figure 20. The production cycle and components of value added

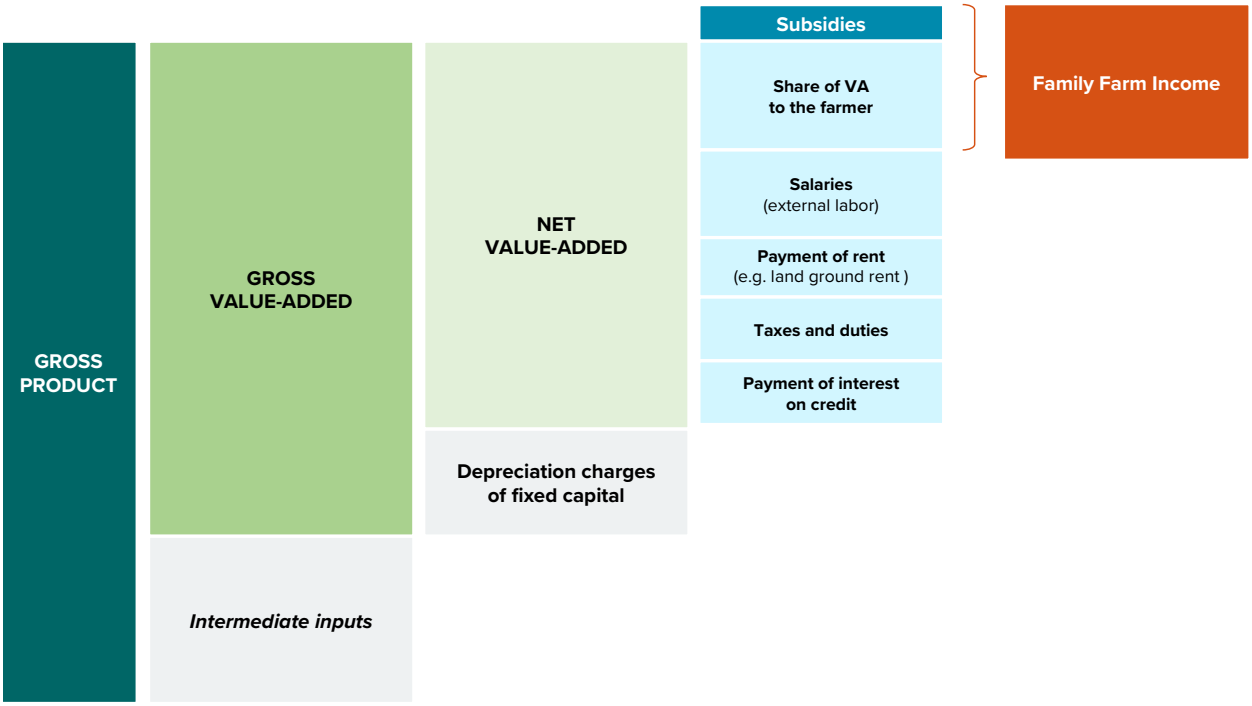


Table 3. Parameters introduced in the modelling of rubber production economics

	Steung Trang						Snuol						Bar Khaev					
Rubber landholding size (ha)	Large		Medium		Small		Large		Medium		Small		Large		Medium		Small	
Price (Boom - Bust phases) - kg per ton DRC	2		2		2		10		5		2		10		5		2	
Use of fertilizer (based on field work in each location) 100% = use for large landholding in boom phase	100%	75%	100%	50%	30%	0%	100%	50%	100%	25%	30%	0%	100%	50%	100%	0%	30%	0%
Use of external labor (based on field work in each location) 100% = use for large landholding in boom phase	100%	75%	50%	25%	0%	0%	100%	75%	50%	25%	0%	0%	100%	75%	50%	25%	0%	0%
Number of years of tapping	20						17						15					
Trees tapped per day	350						325						300					
Yield at Y1 (kg DRC/ha/year)	750						625						675					
Max yield (kg DRC/ha/year)	1575						1400						1500					
Yield last year of tapping (kg DRC/ha/year)	1440						1200						1350					
Intercropping Y1	Soya bean						Mung bean/Soya bean						Soya bean					
Intercropping Y2	Cassava						Cassava						Cassava					
Intercropping Y3	Cassava						Cassava						Cassava					

5.2.2 Creation of value added

Figure 21, Figure 22, and Figure 23 show the variation in value added of rubber production based on different types of calculation. Figure 21 shows the value added calculated per ton DRC of rubber produced over the life cycle of the rubber. Figure 22 shows the value added calculated per ha over the life cycle, and Figure 23 shows the total value added for the entire area and life cycle of the plantation.

Figure 21. Variation of value added (USD/ton DRC), by producer size and location

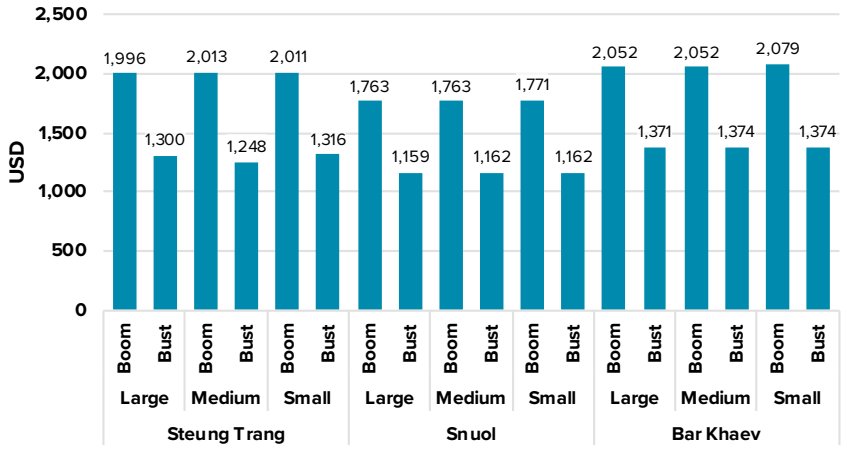


Figure 22. Variation of value added (USD/ha) for total life time of plantation by producer size and location

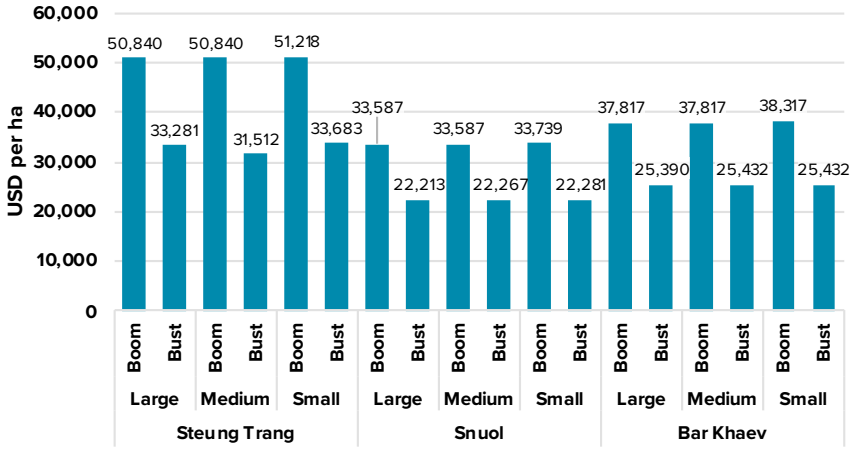
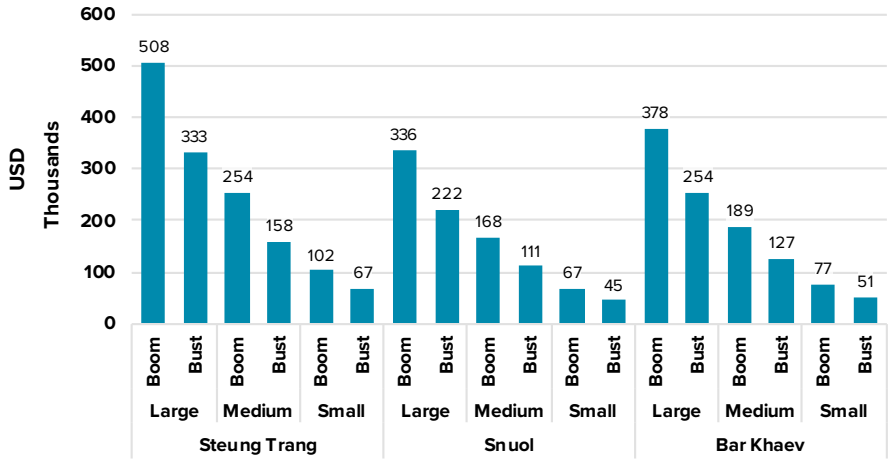


Figure 23. Variation of value added (USD) total area and total life time of plantation), by producer size and location



In a nutshell, the value added varied from US$1,763–2,079 per ton DRC in the boom phase and from US$1,159–1,374 per ton DRC in the bust phase. Calculated per ha for the total life time of a plantation, it varies from $33,587 to 51,218 in the boom phase and from US$22,213 to 33,281 in the bust phase. When the total rubber landholding area and yield profile are factored in, the difference in the total value added is logically more important (Figure 23). It ranges from US$67,000 to 508,000 and from US$51,000 to 333,000 in boom and bust phases, respectively. Notably, there is a constant ratio of 5:1 of total value added between large and small rubber landholdings in the three different districts.

When computed per ton DRC or ha, value added varies more between districts than between rubber landholdings in each district. This is because the yield profile weighs heavily in the total value added.

Also, the value added per ton DRC presents less variation between districts than when it is calculated per ton DRC than per ha. This reflects the effect of the plantation's lifetime, which weighs more in value added per ha than in value added per ton DRC. With 20 years of tapping cycle, Steung Trang is clearly at an advantage compared with Bar Khaev (only 15 years). Despite a shorter lifetime, rubber production in Bar Khaev remains competitive compared with Snuol, because the yield profile is more advantageous in Rattanak Kiri than it is in Kratie province.

The loss of value added between boom and bust periods is remarkably constant between regions and between rubber landholding sizes. In Steung Trang, the loss of value added is 36 percent on average (from 35 percent to 38 percent), 34 percent in Snuol (from 34 percent to 34 percent) and 33 percent in Bar Khaev (from 33 percent to 34 percent). This suggests that the effect of price on rubber value added is relatively homogenous between district and landholding sizes.

5.2.3 Distribution of value added at smallholder rubber production level

The value added serves to pay for the access to the means of production. As such, it consists of the payment of wages to external laborers, the payment of interest to credit institutions, and the labor income of the farmers. The different components of the value added are compared in relative terms (Figure 24) and absolute terms (Figure 25), between boom and bust phases.

Figure 24. Distribution of the value added per hectare in boom and bust phases, by producer size and location

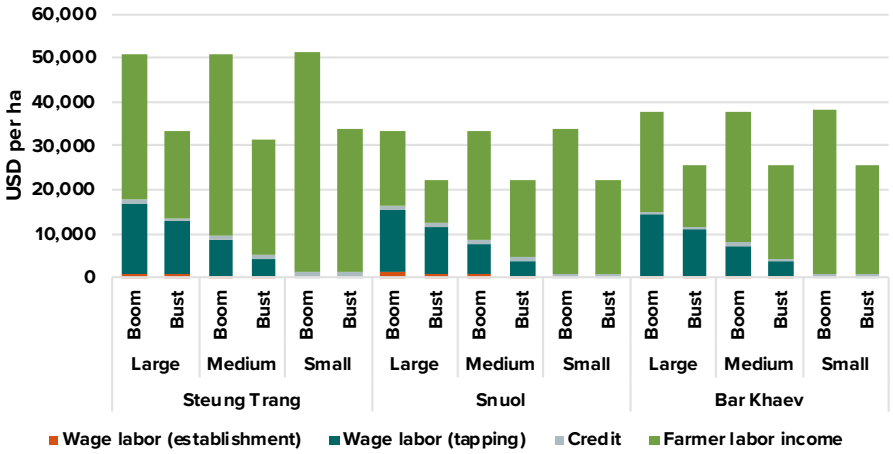
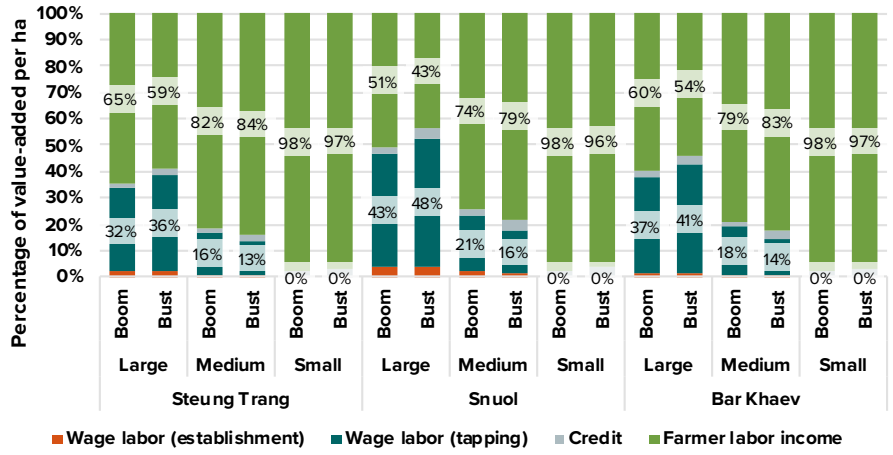


Figure 25. Comparison of the relative share of value added components between boom and bust phases, by producer size and location



The largest part of the value added is used to pay for external labor (from 0 to 52 percent) and to pay for the labor of the farmer and his/her family (from 43 to 98 percent), as shown in both figures.

As shown in Figure 25, the amount paid as wage labor and the family labor income has decreased between boom and bust phases. However, the payment of interest to credit institutions has remained constant, so its relative share in the value added has increased.

For large landholdings, the adaptation to the decline of the rubber price is twofold: the decrease of monthly salary paid to wage workers and the decreased share of the value added that goes to the family as compared with external labor (Figure 25). For households with medium-size landholdings, the drop in rubber price has incentivized family members to undertake tasks (in maintenance and tapping) to reduce the costs. The relative share of family labor income has increased as a result (Figure 25). Households endowed with a small rubber landholdings do not employ external labor, so the family has adapted alone to the decline of rubber prices (Figure 25).

5.3 LIVELIHOOD ADAPTATION TO RUBBER PRICE DECLINE

We asked families about 14 different options to adapt to the decline in rubber prices. These included short-term versus long-term responses, and implied structural changes in the production system of the family versus just a temporary adaptation. The results are presented for the entire sample (n=82) in Figure 26 and for different household types in Table 4.

Figure 26. Percentage of households relying on a given strategy to adapt to the decline in the rubber price

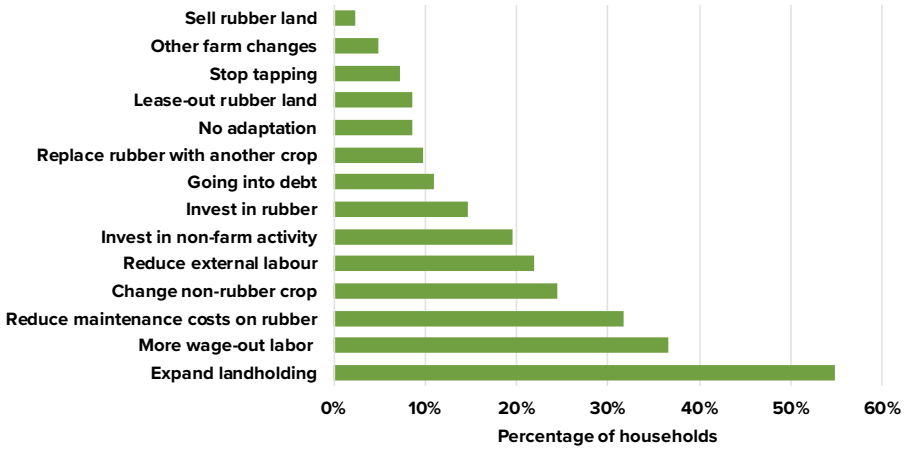


Table 4. Reliance on adaptation strategies for each type of SHR

	Whole Sample		Type of Households		
	Number of households	Total	Small landholding	Medium landholding	Large landholding
Expand landholding	45	55%	25%	54%	88%
More wage-out labor	30	37%	54%	43%	12%
Reduce maintenance costs on rubber	26	32%	25%	36%	35%
Change non-rubber crop	20	24%	25%	36%	12%
Reduce external labor	18	22%	11%	18%	38%
Invest in non-farm activity	16	20%	21%	14%	23%
Invest in rubber	12	15%	11%	11%	23%
Going into debt	9	11%	7%	11%	15%
Replace rubber with another crop	8	10%	11%	4%	15%
No adaptation	7	9%	21%	4%	0%

	Whole Sample		Type of Households		
	Number of households	Total	Small landholding	Medium landholding	Large landholding
Lease-out rubber land	7	9%	0%	14%	
Stop tapping	6	7%	7%	4%	12%
Other farm change	4	5%	4%	0%	12%
Sale of rubber land	2	2%	4%	4%	0%

5.3.1 Moving away from rubber is not an option

The reduction of maintenance and external labor costs (Table 4; Figure 26) associated with the increased use of family labor is an important response to the decline in the rubber price, particularly for rubber farmers who own a large agricultural holding. Yet the sale or the leasing out of rubber land or the cessation of tapping is not an option for the vast majority of smallholder rubber farmers, simply because they cannot afford it. Rubber represents a considerable investment (in labor and capital) and is central in supporting their livelihoods. Regular income from rubber is crucial to manage the repayment of their loans, and/or the investment in other crops or other activities. While persevering with rubber and waiting for the price to bounce back, they are confident that existing trade networks will remain in place despite the economic downturn.

This logic greatly differs from the situation of large plantations that have often stopped their processing operation, put their plantations into a care/maintenance mode, or extended the no-tapping rest period from two to four-five months.

This contrast reveals not only the strategic importance of rubber for smallholder households but also the sector as a whole. Combining the support of a productive and robust smallholder rubber sector and channeling its latex to processing units (RSS or TSR) located in Cambodia is a long-term strategy for the sector. This requires better management of the value chain.

5.3.2 Differentiated responses to the drop in the rubber price

The various smallholder groups identified above adapt differently to the decline in the rubber price. Households with large landholdings tend to adopt long-term strategic mechanisms (expanding agricultural landholdings including for the production of rubber) while those with small landholdings rely on short-term responses, such as more off-farm wage labor, a reduction in maintenance costs, etc. Altogether, the outcomes of these different adaptation mechanisms reinforce the pattern of differentiation described above.

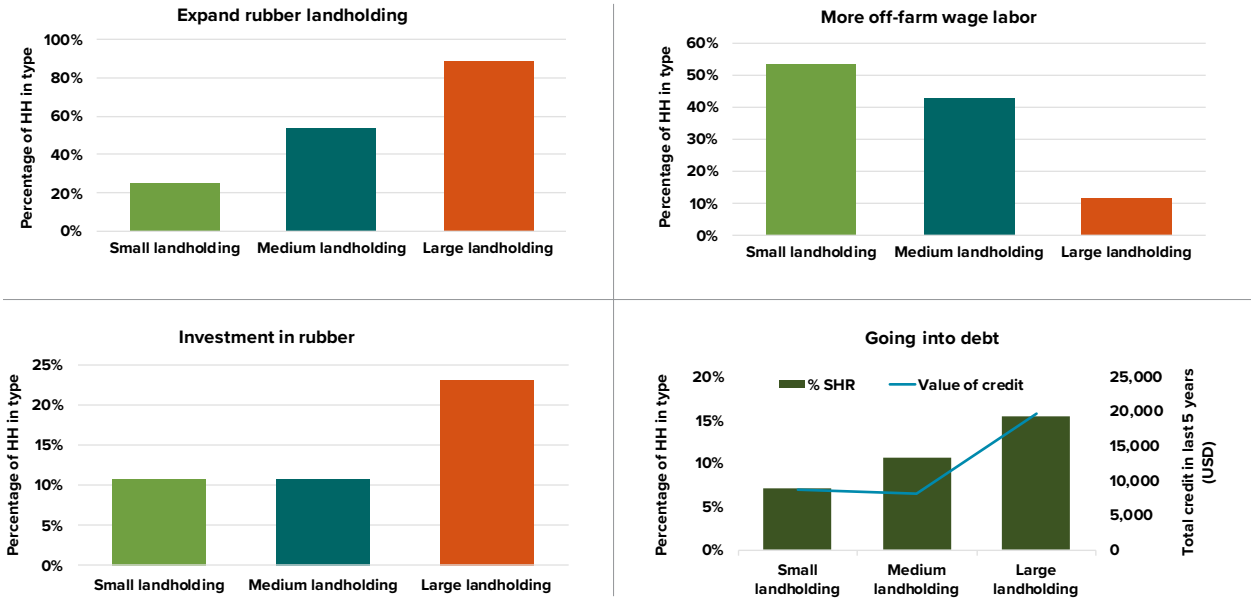
The expansion of agricultural landholdings is by far the most important response to the decline in rubber prices. As seen above, this works through clearing, or the purchase of recently cleared, land (with cashew as a pioneer crop for the reasons explained above). As shown in Figure 27 (see graph at upper left), the larger the agricultural landholding, the higher the number of farmers who opt for this response. This category of rubber farmer is behind most of the deforestation associated with post-2012 deforestation.

The idea that the poor migrant in desperate need of land is the main driver of deforestation does not hold

true here. Even if deforestation is the main vehicle for expanding agricultural landholdings, land markets also play a role as a response to declining rubber prices. By taking advantage of the economic downturn of the sector and anticipating the price recovery, some smallholders have invested in the purchase of established rubber plantations (Figure 27, lower left). On the supply side, the transaction is always a distress sale and relates to a family that is going under.

On the other hand, farmers with small landholdings are more dependent on off-farm wage labor as a result of the decline in the rubber price (Figure 27, upper right). Brought together, these contrasting responses reinforce a process of economic polarization between smallholder rubber farmers, with the accumulation of land on the one hand, and an increased reliance on off-farm wage labor on the other.

Figure 27. Adaptation to a drop in the rubber price and differentiation among smallholder rubber farmers



This polarization is mirrored in the uptake and the use of credit by farmers (Figure 27, lower right). Those with large landholdings are relatively more inclined to acquire credit and to borrow more than the others. The uptake of credit is usually driven by investment in productive activities (purchase of land or other productive non-farm activities). Households with smaller landholdings borrow less and usually for more vital uses (i.e., food or health care).

6 Rubber Value Chain Dynamics

This section presents some key organizing principles of the rubber value chains in Cambodia. Against this backdrop, it examines how the rubber price influences the creation and distribution of value added along the different segments of the commodity chain (from production to export).

6.1 SMALLHOLDER FARMER SALE OF RUBBER AS COAGULUM OR LATEX: A TRADE-OFF

Smallholder rubber farmers have two options when they sell their rubber production. One is to sell it as latex on the very day of tapping for domestic processing into TSR or RSS. The second option is to proceed with on-farm coagulation, which allows them to keep the product for a longer period and enables a more flexible sale to middlemen.

The sale of latex makes sense in theory: it would help RSS and TSR processing units to source latex and increase their processing turnaround. However, for the most part, the rubber value chain is organized in Cambodia in a way that favors on-farm coagulation and the informal export of unprocessed rubber to Vietnam, at the expense of domestic processing and formal export.

Several structural elements result from this state of affairs. The trade and export of coagulum through the border to Vietnam aims to avoid the export tax on processed rubber, which amounts to US$50 per ton DRC. Research has shown that the costs of red tape associated with informal trade are equivalent to US$10 per ton DRC (GLG and CIRAD 2018). Thus, informal export is clearly at an advantage and the greater margin is an incentive for exporters.

In Cambodia, the value chain is organized to transmit this incentive to the smallholder rubber farmers and to encourage them to proceed with on-farm coagulation of their production. First, a small price differential is actively maintained to put coagulum at an advantage over latex. This intervention in the market is managed through an opportunistic and strategic arrangement between influential traders on both sides of the border. Cambodian traders who export unprocessed rubber gain from the transaction. Furthermore, Cambodian coagulum is also of interest to the growing Vietnamese rubber processing industry. With the closure of the border during the Covid pandemic, no transport trucks were allowed to cross the border from Cambodia into Vietnam, so the ability of Vietnamese traders to control the price and quantity was even higher during this period.

Three other elements also work in favor of on-farm coagulation for smallholder rubber farmers:

- The tapping, collection, and transport of latex within a day requires a quick turnaround for smallholder rubber farmers. In many regions, where the transport facilities for latex are non-existent or inefficient, it is difficult for them to proceed, let alone accommodate the risk associated with rain and loss during transportation.

- Middlemen offer payment on the spot when they purchase coagulum from smallholder rubber farmers. For latex, it takes several weeks for owners of processing units to pay the farmers.
- The value added of the higher-value latex-grade rubber exported is usually not transmitted to smallholder rubber farmers, so no equivalent could create an alternative incentive.

However, this general pattern is not homogenous across the rubber landscapes of the country. The distance to the Vietnamese border is quite influential: the closer to the border, the higher the density of traders, the higher the incentives given to smallholder farmers to undertake on-farm coagulation, even if the distance between the smallholders' rubber plantation and the processing unit is within a day's reach. In reverse, in regions where there is a history of collaboration between processing industries and smallholder rubber farmers (and thus a measure of trust), the premium price obtained if a high grade of rubber is produced can be transmitted to farmers, which incentivizes them to sell latex. As we can see below, this is particularly the case when the market interface is facilitated by a rubber cooperative.

As discussed earlier, the decline in rubber prices on the international markets has had an immediate effect on the value added of the producers, who have become more sensitive to small price differences. It has reinforced the advantage of coagulum over latex. The decline in rubber prices is concomitant with the large increase in rubber production that has resulted from the significant area of rubber planted in 2008–2013 becoming mature in 2014–2019 (see above). This gave a small inducement to exporters to maintain the price of coagulum at a higher level than that of latex, despite the overall decline in the rubber price.

Such a configuration of the rubber value chain comes with environmental, economic, and social consequences. On-farm coagulation requires the use of formic or sulfuric acid. When not properly managed, this can lead to soil acidification and threatens plantations in the long term. While the bulk of rubber production is exported unprocessed, the domestic processing units have a difficult time sourcing latex to run at full capacity. TSR factories are limited to processing the production of the appending plantation. In some cases, they have shifted their plantation to care and maintenance operations. A significant number of RSS processing units are limiting their operations with latex sourced from their plantation or have brought their operation to a complete standstill. This results in market concentrations between operators, the bigger being able to maintain their activities and reinforce their dominance in the value chain, which will be crucial if (or when) rubber prices swing upward again.

6.2 VALUE ADDED CREATION AND DISTRIBUTION ALONG THE VALUE CHAIN

Our fieldwork data partly allow us to model how the value added is created along the entire value chain and how it is distributed between the different stakeholders. To complement and validate our dataset relating to the economics of production, we derived processing-related data from the 2018 GLG-CIRAD report. The following parameters have been considered for the calculation:

- Price sets are based on our fieldwork conducted in 2020–2021 (farm gate price of US$1,300/ton DRC)
- Direct processing costs include consumables, energy, and labor
- Indirect processing costs include depreciation, financial costs, and overheads

Table 5. Free on Board (FoB price[9] structure and value-addition along different rubber value chains (in USD)

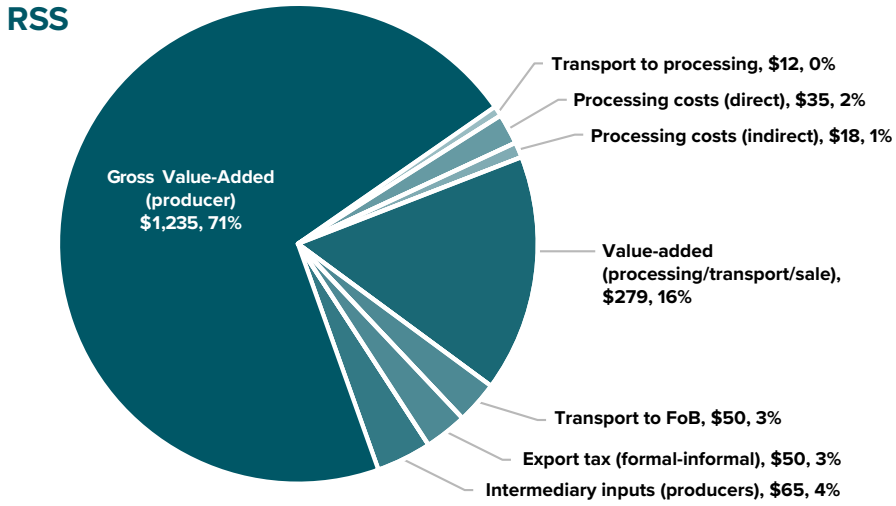
	TSR	RSS	Coagulum
Farm gate price	$1,300	$1,300	$1,350
Intermediary Inputs (producers)	$65	$65	$70
Gross Value Added (producer)	$1,235	$1,235	$1,280
Transport to processing	$12	$12	$0
Processing costs — direct (except labor)	$70	$36	$0
Processing costs — direct (labor)	$35	$48	$0
Processing costs (indirect)	$34	$18	$0
Value Added (processing/transport/sale)	$100	$279	$50
Transport to FoB	$50	$50	$60
Export tax (formal-informal)	$50	$50	$10
FoB selling price	$1,616	$1,745	$1,470
Ratio farm gate/FoB price	80%	74%	92%

The addition of value is more important when the latex is processed into RSS (16 percent of the FoB price) as opposed to TSR (6 percent of the FoB price); see Figure 28 and Figure 29, respectively. This results from the combined effect of the higher sale price and more labor-intensive processing, as opposed to the more capital-demanding processing into TSR. Overall, the ratio between the FoB price and the farm gate price is 80 percent for TSR and 74 percent for RSS, which is consistent with other reports (GLG-CIRAD, 2018). The comparative advantage of the RSS unit in terms of value added creation, combined with the relatively low capital investment to establish it, makes this a technology that is accessible to smallholders.

Coagulum is sold at a cheaper and more competitive price for Vietnamese importers but there is no value-adding process in the country (Table 5; Figure 30). The post-production value added is cashed by the exporters and results in a considerable loss of value added for the sector. The consequences are sizable in terms of employment and job creation, service provision, and local economic diversification as well as the positioning of Cambodia in the international rubber markets.

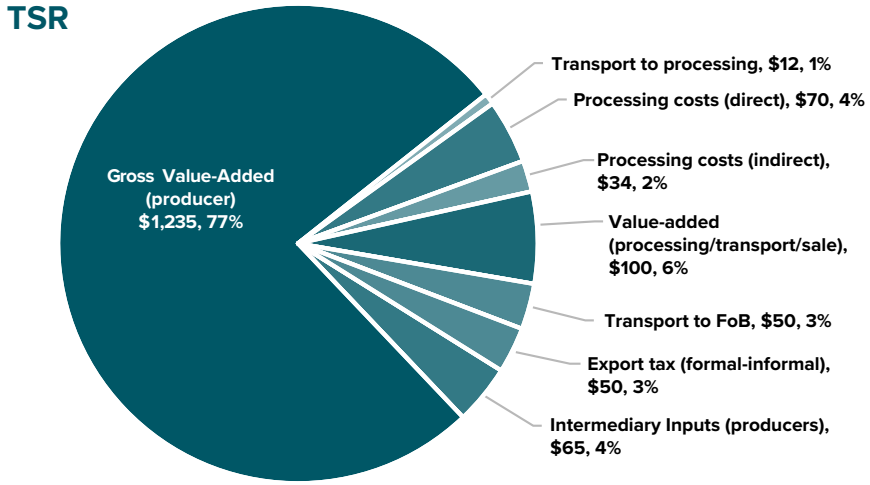
[9] Free on Board price include the cost of delivering rubber to the nearest port before shipment

Figure 28. Free on Board price structure and value added along the value chain, with RSS processing.



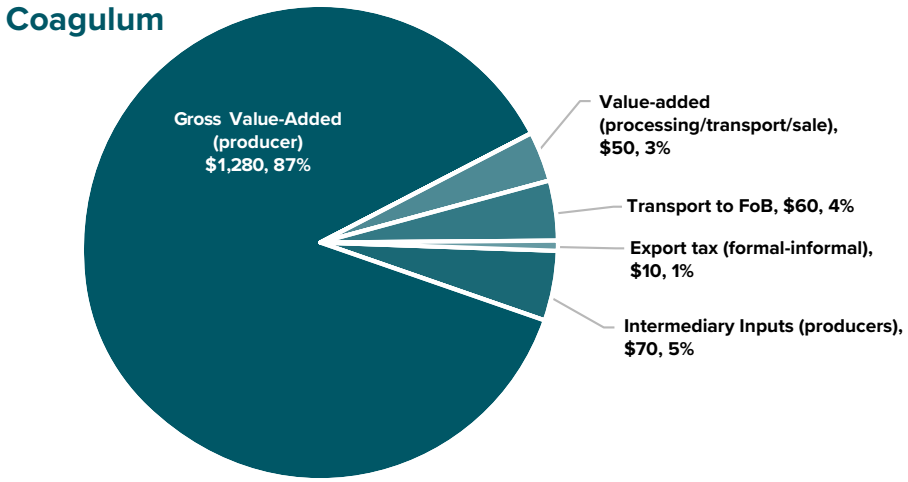
Notes: All prices in USD.

Figure 29. Free on Board price structure and value added along the value chain, with TSR processing



Notes: All prices in USD.

Figure 30. Free on Board price structure and value added along the value chain, without domestic processing



Notes: All prices in USD.

6.3 MARKET CONFIGURATIONS OF RUBBER VALUE CHAIN FOR SMALLHOLDER RUBBER FARMERS

To understand the insertion of smallholder rubber farmers into rubber value chains, we identify three main market configurations based on the role and influence of several stakeholders from production to export. These configurations are named after the factor that has the highest influence in the organization and functioning of the value chains:

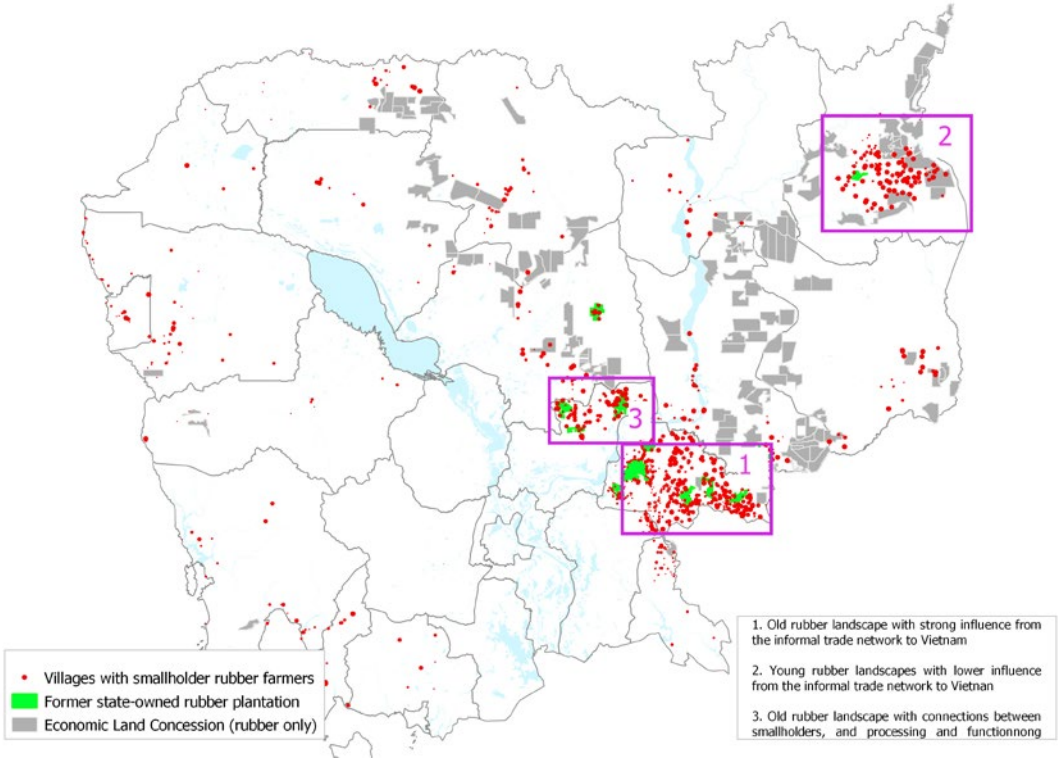
- Old rubber landscape with strong influence from the informal trade network to Vietnam
- Young rubber landscape with lower influence from the informal trade network to Vietnam
- Old rubber landscape with established connections between smallholders, and processing units, and functioning cooperatives

The market flow, volume percentage, and prices are indicative of the situation we encountered in the rubber landscapes we studied. They do not necessarily capture the diversity of market arrangements found along the value chain in different parts of the country, particularly those found along the Thai border. Table 6 below describes each of these configurations:

Table 6. Key characteristics of the three value chain configurations for smallholder rubber production

	1 Old rubber landscape with strong influence from the informal trade network to Vietnam	2 Young rubber landscapes with lower influence from the informal trade network to Vietnam	3 Old rubber landscape with connections to processing and active rubber cooperatives
Smallholder rubber production	Large number of small rubber landholdings, close to VN	Smaller number of planters but larger rubber landholdings	Large number of small rubber landholdings
Distance to Vietnam	Close	Far	Close
Distance to processing units (TSR or RSS)	Medium	High	Short
Cooperative	Inactive/dysfunctional	Inactive	Active/functional
Share of production sold as coagulum	99percent	80percent	15percent
Key influencers of the value chain	Exporters and network of collectors	Exporters and local processing agents	Processing agents

Map 4. Location of different value chain configurations identified



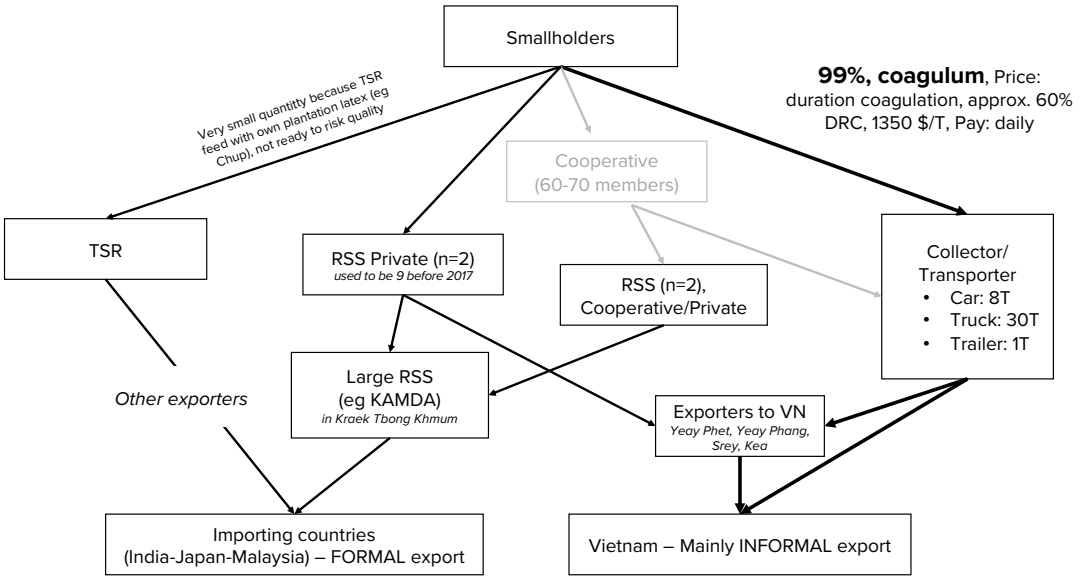
6.3.1 Rubber value chain directly influenced by informal trade to Vietnam

We find this configuration in hotspot production areas close to the Vietnamese border, typically in Tbong Khmum province (Map 4). The region includes many collectors who provide incentives to smallholder rubber farmers to sell coagulum instead of latex (Figure 31). This web of collectors/traders is working directly or indirectly for major exporters who fix the price of coagulum (ranging according to the duration of coagulation but systematically higher than the latex price per kg DRC). Their control of the market is made possible because most smallholder rubber farmers have small landholdings (Annex 1), and the number of processing units is limited, so the distance smallholders need to cover to reach an RSS or TSR is considerable. In this context, smallholder rubber farmers are interested in easy options to sell their products.

The tiny share of the production that goes as latex to RSS processing units is usually the product of the RSS processor. The number of RSS processors has dropped dramatically over the last few years because they cannot source latex. The few processing units still in operation run with the rubber production of their owners. For the same reason, a rubber cooperative could not compete with the coagulum market, and their operation is limited to selling the latex production of a handful of people, usually those who lead the cooperative. Smoked sheets produced in these small RSS units are sold to larger RSS processing plants that manage the export process.

The TSR processing units have larger plantations appended and are still processing rubber. They could buy latex from smallholders but usually do not. Most of them are not ready or willing to conduct quality checks to ensure homogeneity of quality between their own rubber and the smallholder out-growers' rubber.

Figure 31. Organization of the rubber value chain in regions close to the border with Vietnam under the influence and control of coagulum collectors (Memot, Tbong Khmum)



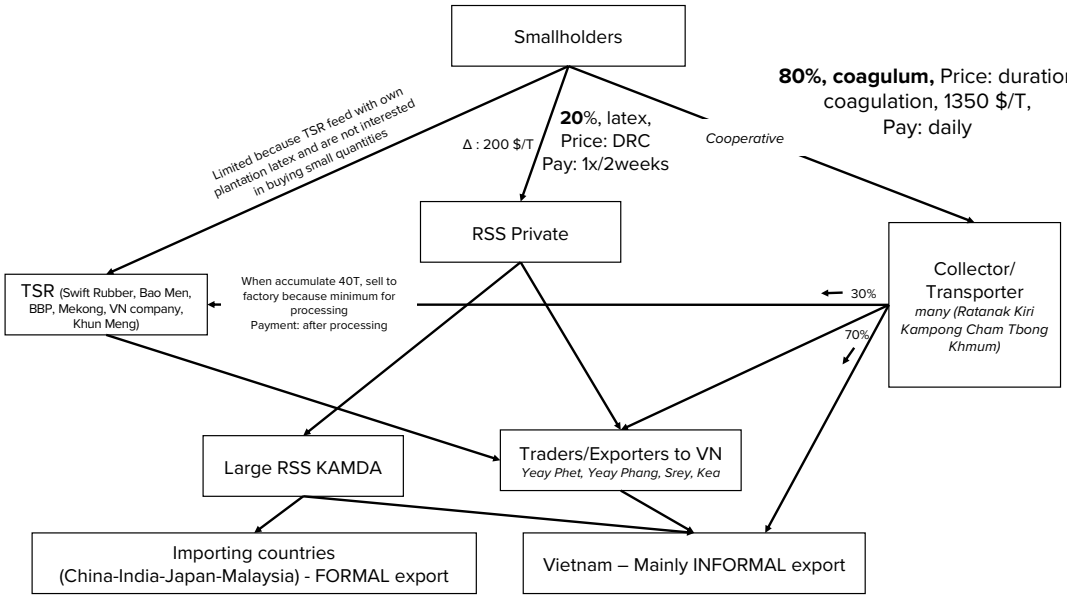
The choice of smallholder rubber farmers to sell coagulum instead of latex is rational but it can lead to the collapse of small-scale processing units in Cambodia. TSR units manage to maintain their operations using produce from their own plantations but they are also failing. Altogether, the decline in rubber prices has strengthened these trends. The decline in the value added at the producer level has reinforced the attractiveness of coagulum, and further reduced the part of the production that feeds domestic processing

units. At the same time, the demand for rubber from Vietnam has not declined, which has contributed to maintaining this state of affairs.

6.3.2 Rubber value chains with relatively lower influence from informal trade to Vietnam

In more remote rubber landscapes, we find a similar configuration to that of the rubber value chain. An estimated 80 percent of the production is sold as coagulum and ends up being informally exported to Vietnam under the influence of the same group of key exporters. However, due to its relative remoteness and the large distance to Vietnam, the transport system is better organized and the balance of production (20 percent) goes to local processing (Figure 32). Combined with relatively more important large landholdings among smallholder rubber farmers, local RSS processing performs better than it does in Tbong Khmum.

Figure 32. Organization of the rubber value chain with relatively lower influence from informal trade to Vietnam (Bar Khaev, Ratank Kiri and Snuol, Kratie)



6.3.3 Rubber value chain with relatively easy access to processing units and active rubber cooperatives

In areas where cooperation between processing units and smallholder rubber farmers is more historically rooted, with a higher density of RSS/TSR processing units and a higher production volume (Map 4), the organization of the value chain can be quite different (Figure 33). This was confirmed by our studies in the area surrounding a former State-owned plantation (Boeung Khet) in Kampong Cham province.

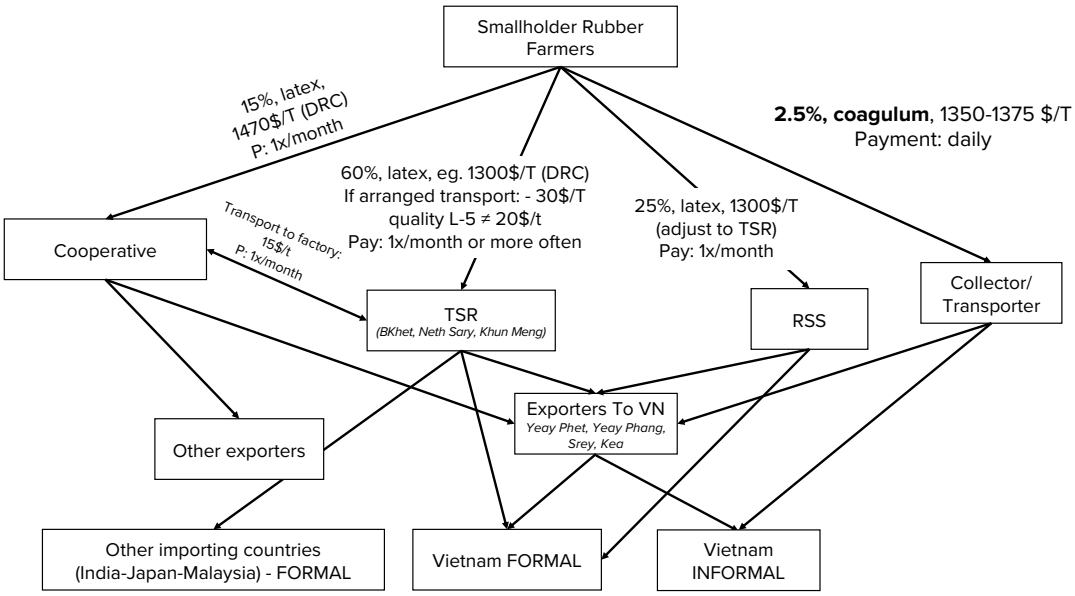
Even if the prices offered by collectors or middlemen for coagulum are slightly higher than they are for latex (US$1350–1375 per kg DRC, depending on the duration of coagulation, versus US$1300 per kg DRC for latex), a relatively small quantity of rubber is channeled through informal trade routes to Vietnam. As such, this contrasts with practices in the rest of the country. Another element playing in favor of rubber sale as latex is the risk of coagulum theft on the plantation.

In this configuration, the well-organized transport systems and a relatively short distance to be covered to reach the processing units, offer a credible alternative for smallholder rubber farmers. They sell latex either to TSR (60 percent of production) or to RSS (25 percent) processors if they are situated within a 10 km radius of the plantation. RSS processors usually align their prices to those offered by their TSR counterparts. Transport is organized by the farmers directly or by the company, in which case US$30 per ton DRC is deducted to cover this.

Part of the latex (15 percent) is collected by a local active rubber cooperative group that transports it to a TSR processor, situated nearby, based on a specific and negotiated agreement relating to price and quantity. After processing, the cooperative sells the rubber crepes to exporters, which allows them to gain a premium price if the Free on Board (FoB) selling price allows for it. The premium price is then transmitted to the cooperative members and helps the cooperative to cover transport and administrative costs.

The yo-yo effect of rubber prices (boom-bust) has not altered the organization of the value chain. Local collectors of coagulum are competing to provide incentives for smallholder farmers. Yet, this situation represents a credible alternative to smallholder rubber farmers who still prefer to sell latex, despite the delay in payment.

Figure 33. Organization of the rubber value chain with relatively easy access to processing units and active rubber cooperatives (Ou Mlu, Stueng Trang)



A rubber cooperative is an important, yet underdeveloped, mechanism to facilitate and enhance access to market and new techniques for smallholder rubber farmers. It can take time before a rubber cooperative can sell processed rubber at a price that allows for a profit. It then faces fierce competition from traders who offer a more competitive price and quicker payment turnaround. Another issue is that most of the farmers are reluctant to deal with cooperatives because they do not trust their financial management. Therefore, adequate, and timely funding of the rubber cooperative would help. There is a need for cooperatives to be supported so that they can:

- Provide credit for cooperative members at lower interest rates and involving less paperwork (if compared with a microfinance institution)
- Pay cooperative members directly, which would ease the contracting process with buyers/processing plants
- Invest in their own processing and in selling the final products directly to the international market/ buyers. Alternatively, the cooperative could rent out the RSS from the owner is in difficult financial situation.

7 Legality Issues and Ways Forward

The nuanced dynamics of the smallholder rubber sector are often poorly understood by downstream rubber industry stakeholders who, with the best of intentions, have committed to eliminating rubber linked to deforestation (or at the very least, illegal deforestation) from their supply chains.[10] Our analysis shows that, since 2013, rubber has stopped being a primary driver of deforestation in Cambodia. Deforestation continues unabated, but is now driven by other annual and perennial commodity crops, such as cassava and cashew. A nuanced and careful analysis linking rubber, smallholder farmers, and deforestation is therefore much needed.

On the policy front, there have been several significant legislative developments in major consumer markets on commodity-driven deforestation (Trase 2022). These include:

- **United States:** In October 2021, the Forest Overseas Rule of Law and Environmentally Sound Trade (FOREST) Act was introduced in the US House of Representatives. The Act prohibits the import of designated products containing commodities sourced from land *illegally* deforested after the date of enactment. Rubber is included in the initial list of covered commodities, which would be reviewed annually. The Act would be applicable to large companies, and traceability requirements are unclear.
- **United Kingdom:** The UK adopted a new Environment Act in November 2021, which contains new regulation on forest-risk commodities related to commercial activities, most significantly, a prohibition on using deforestation-linked commodities and their derivatives that have not been produced in accordance with local laws related to ownership and/or use of land. Secondary legislation is required to determine which commodities and businesses will be in scope, how regulated actors must conduct due diligence and make disclosures, and penalties for non-compliance.
- **European Union:** The European Union regulation on deforestation-free supply chains that came into force in June 2023 is notable in that it mandates that commodities can only be placed on the EU market if they are entirely deforestation-free after December 31, 2020 — rather than simply produced in compliance with producer country laws and regulations (EU 2023a). Rubber is one of the seven commodities regulated by this directive. The due diligence requirements would include a risk assessment and mitigation framework as well as a country benchmarking system that details obligations based on risk classification, and geolocation of all plots of land where commodities are produced. However, rubber is not included in the initial product scope. The regulation on Corporate Sustainability Due Diligence also adopted in 2023 further expands environmental-related regulations to all human rights issues (EU 2023b).

It is critical that policymakers crafting these new legislative measures work closely with stakeholders in Cambodia (and other tropical forested countries) to ensure that implementation is possible in contexts where value chains are complex, tenure security is unclear, legal frameworks may be contradictory, and landscapes include multiple forest-risk commodities. The UK in particular has stressed such cooperation, and both industry

[10] The Zoological Society of London's SPOTT tool assesses natural rubber producers, processors, and manufacturers on their ESG policies related to rubber supply chain. See: https://www.spott.org/natural-rubber/

associations and civil society groups have highlighted the need for clearer support for smallholders to comply with the European Commission's proposal (including financial support, technical assistance, and market access). Many resources need to be mobilized to effectively monitor these regulations and avoid smallholder farmers disproportionally bear the responsibility for commodity-driven deforestation.

Legality issues are not limited to forest management. The scope and production of rubber by smallholder rubber is largely underreported, as is the volume of coagulated latex that is exported informally across the border to Vietnam. This export of coagulum was at odds with the 2003 ban on the export of unprocessed rubber (RGC 2003), and it complicates traceability of rubber produced in Cambodia. In 2022, as a realization that this ban was not realistic and practical for the rubber sector, the government repealed the export ban, officially to give options to smallholder rubber farmers and allow them to increase their profit (RGC 2022). This change in the legal framework notwithstanding, the export of unprocessed rubber implies that the domestic processing units have a difficult time sourcing latex to run at full capacity. The economic losses are substantial in terms of value added creation and job creation. Here again it is the responsibility of public institutions and their advisors to ensure that legality issues are properly addressed in a way that is not detrimental for smallholder farmers.

8 Conclusions

This report aimed to examine how the downturn in the rubber market of the last decade has affected the dynamic of smallholder rubber farmers. The analysis looks at changes in three main areas: i) land and forest resources management at the landscape level; ii) rubber production and adaptation at the household level; and ii) the entire rubber value chain.

- At the landscape level, we have shown that rubber prices influence the dynamic of smallholder rubber farmers but do so in conjunction with other factors in complex socio-ecological systems (the market dynamics of other crops, migration to upland areas, ELC implementation, titling, and the biophysical environment). We identified three main pathways of land-use change that are the contingent outcomes of interactions between these factors. Before 2012, rubber and cashew production were important drivers of deforestation for smallholders. But rubber is planted in areas that combine land tenure security with good edaphic conditions. As such, the titling campaign conducted in 2012–2013 under Order 01 provided a key incentive for the conversion of cashew to rubber farming. After 2012, the contribution of rubber to deforestation has been limited because of more unclear land tenure and the limited availability of suitable soil. Meanwhile, cashew production continues to be a strong driver of deforestation on lower quality land.
- Despite the diversity of the local context, the trajectories of smallholder rubber farmers have evolved following similar patterns. As many rubber hot spots are shaped by migrations, a key aspect of the differentiation between households relates to the time of the arrival of migrants and the upfront capital they have available for investment. We noted a quick process of differentiation among smallholder rubber farmers between a few who accumulate wealth (despite low rubber prices) and many who were struggling to make ends meet. As a result, the general category of “smallholder rubber” hides a large diversity of situations between those who had small, medium, or large landholdings. In terms of adaptation, the different smallholder groups have adapted differently to the decline in rubber prices. Households with large landholdings tend to adopt long-term strategies (i.e., to enlarge agricultural landholdings including rubber expansion) while households with small landholdings rely on short-term responses (i.e., more wage labor, a reduction in maintenance costs, etc.). Altogether, the outcomes of these different adaptation mechanisms reinforce the pattern of differentiation observed. Smallholder rubber farmers stick to rubber and do not plan to move away from it — very few are selling rubber in order to take on something else. This is because they hope the price will bounce back and because, unlike other crops, they consider that the rubber trade networks are solid and will remain in place, despite the economic downturn of the sector since 2013. More than ever, rubber remains a strategic and resilient crop.
- At the economic level, we have shown that the decline in the rubber price has had a significant effect on the value added creation at producer level. The loss of value added between boom and bust periods is remarkably constant between regions and landholding sizes and is heavily proportional to the change in price: 36 percent in Steung Trang, 34 percent in Snuol, and 33 percent in Bar Khaev. The effect of price on rubber value added is relatively homogenous between districts and landholding sizes. At the value chain level, we observed that the price drop has reduced the profit margin at the

producer level. And, due to all the incentives given to them for on-farm coagulation, the price decline has reinforced the informal trade of unprocessed rubber exports to Vietnam. This has resulted in domestic processing units running dry and experiencing an economic crisis.

The role that smallholder rubber farmers play is central to the rubber sector. At the production level, rubber farming creates jobs and contributes to poverty alleviation. Unlike production on large estates, which fluctuates based on price, smallholder rubber farmers do not stop tapping and so help to secure the production of latex which is vital for the domestic processing industry and key to the strategic position of Cambodia in the region. Despite their centrality in the sector, smallholder rubber farmers, and particularly those with small rubber landholdings, face several constraints that considerably limit their growth and, with it, the development of the sector. Rubber cooperative groups currently do not benefit from appropriate technical and economic support which could help them become more autonomous and have a greater voice among other stakeholders in the commodity chain. The post-production sector that could flourish with smallholder rubber latex is squeezed by the current organization of the value chain that favors and incentivizes the informal export of unprocessed rubber. All these problems predated the boom-bust, but the yo-yo dynamics of prices have magnified and reinforced these patterns.

9 Recommendations for Cambodian Stakeholders

These research findings, together with discussions held during the consultation workshop, allowed us to formulate recommendations for different stakeholder groups involved in supporting the development of smallholder rubber farming in Cambodia. With a view on the entire value chain, we suggest a systemic approach that activates changes on different issues simultaneously. We differentiate between issues requiring immediate and actionable next steps and others that are longer term tasks. We identify the different stakeholders whose contributions are required and identify the actor who shall have a leading role.

	Time Frame		**Stakeholders** (* = leading role)							
	Actionable next steps	**Longer-term possibility**	**Government**	**SHR**	**Rubber Cooperatives**	**Banks**	**Companies**	**Processors**	**Traders/ Exporters**	**Research**
IMPROVING THE RELATIONSHIP BETWEEN PROCESSING UNITS AND SMALLHOLDER FARMERS										
Incentivize exporting rubber in forms other than coagulum by:										
• Supporting the development of an efficient collection system for latex (from smallholder plots to domestic processing units);	☑		☑*		☑	☑	☑	☑		
• Enhancing communication between value chain actors to improve information exchanges about quality standards, market expectations, and requirements (quality, quantity, and timing). This is a prerequisite to convince TSR units to buy quality latex from smallholder rubber farmers;	☑		☑*	☑	☑		☑	☑	☑	
• Piloting mechanisms to transmit a share of premium prices to smallholder rubber farmers through partnerships with RSS and TSR processors (with secured floor price + premium based on quality produced)	☑				☑		☑			☑
• Supporting and developing RSS processing units that create more value added and are more affordable for smallholder rubber farmers		☑	☑*		☑	☑	☑			
• Equipping TSR lines to increase their capacity to process coagulum into high-quality-grade rubber		☑				☑	☑			
Increase the competitiveness of domestic processing in Cambodia, e.g., by reducing electricity costs.		☑	☑*							

	Time Frame		Stakeholders (* = leading role)							
	Actionable next steps	Longer-term possibility	Government	SHR	Rubber Cooperatives	Banks	Companies	Processors	Traders/ Exporters	Research
ENHANCING THE ROLE OF RUBBER COOPERATIVES										
Provide and monitor access to credit with a low-interest rate for cooperatives to:										
• Proceed with quick payment to members	☑				☑	☑				
• Invest in the processing facilities for smallholder farmers, particularly to promote cooperative-managed RSS processing	☑				☑	☑	☑			
• Create groups/associations of cooperatives to increase aggregate volume for direct export		☑	☑		☑					
Build trust among members and not-yet-members through communication and transparent financial management and operations.		☑	☑	☑	☑					
LAND TENURE SECURITY										
Grant titles for rubber areas that remain untitled after Order 01, while making the titling process simple and accessible for landholders with limited resources.	☑		☑*	☑						
Develop partnerships between large estates and smallholder rubber farmers, e.g., nucleus estates and rubber out-grower schemes.	☑		☑*	☑	☑*		☑*			☑
Develop clear land-use plans to increase land tenure security.		☑	☑*		☑					☑
Prioritize conflict resolution and develop clear grievance mechanisms to be used when land conflicts arise.		☑	☑*		☑					
TRADE AND EXPORT										
If export tax is maintained, use part of this revenue to support smallholder rubber farmers.	☑		☑							
Carefully examine the issues revolving around the informal export of coagulum.		☑	☑							☑
Put in place affordable mechanisms to check and ensure rubber quality for export markets.		☑	☑				☑	☑	☑	
Diversify the export market to other countries and develop facilities for Cambodia to be able to export directly to countries that use rubber in manufacturing.		☑	☑						☑	

	Time Frame		Stakeholders (* = leading role)							
	Actionable next steps	Longer-term possibility	Government	SHR	Rubber Cooperatives	Banks	Companies	Processors	Traders/ Exporters	Research
Put in place credible mechanisms to certify the quality of the Cambodia rubber for international market stakeholders.		☑	☑				☑	☑	☑	
RUBBER PRODUCTION AND LAND-USE MANAGEMENT										
Monitor tree cover loss, deforestation, and forest degradation, with a focus on identifying both direct and indirect drivers.	☑		☑*							☑
Promote tree species intercropping in rubber plantations and provide licenses for timber commercialization.	☑		☑*	☑			☑			☑
Improve smallholder access to the market for quality planting material.	☑		☑*	☑	☑					
Improve tapping management: avoid early opening, ensure more consistent use of stimulation, and improve tapping quality.	☑		☑*	☑	☑					
Develop audiovisual training materials for rubber plantation management, and make these materials easily accessible online.	☑		☑*	☑						
In addition to rubber, promote the production of other crops and farm activities to build resilience and capacity to adapt to future economic shocks.		☑	☑*	☑	☑					☑
BRINGING RESEARCH TO THE NEXT LEVEL										
Identify rubber varieties that match specific soil quality.	☑		☑							☑
·Explore the better management of soil fertility and the sustainability of on-farm coagulation practices using formic or sulfuric acid.	☑		☑							☑
Conduct economic analysis of mixed plantations with an association between rubber and high-value timber.	☑		☑							☑
Better understand the factors that enhance agricultural diversification and evaluate the environmental, social, and economic benefits of agricultural diversification (as opposed to rubber mono-cropping), e.g., the intercropping with tree species.		☑	☑							☑
Conduct economic analyses of rubber production and comparative analysis with other crops.		☑	☑							☑

	Time Frame		Stakeholders (* = leading role)							
	Actionable next steps	Longer-term possibility	Government	SHR	Rubber Cooperatives	Banks	Companies	Processors	Traders/ Exporters	Research
Examine the regulation of the domestic and international rubber markets.		☑	☑							☑
Examine the role of non-farm activities in labor diversification and income formation mechanisms.		☑	☑							☑

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11 Annex

Number and area of the landholdings of smallholder rubber farmers in Cambodia

	Households	Area (ha)	Average (ha/HH)
Tbong Khmum	18,183	46,996	2.6
Ratanak Kiri	2,361	37,808	16.0
Kampong Cham	2,913	20,745	7.1
Kratie	3,310	13,689	4.1
Mondul Kiri	1,606	11,305	7.0
Kampong Thom	686	7,702	11.2
Stung Treng	540	4,807	8.9
Preah Vihear	448	3,454	7.7
Battambang	206	2,091	10.1
Oddar Meanchey	117	1,809	15.5
Pailin	114	1,546	13.6
Prey Veng	728	1,461	2.0
Koh Kong	180	1,426	7.9
Sihanoukville	76	1,221	16.1
Siem Reap	49	1,039	21.2
Svay Reang	216	989	4.6
Banteay Meanchey	30	927	30.9
Kampong Speu	14	866	61.9
Pursat	299	777	2.6
Kampot	24	447	18.6
TOTAL	**32,100**	**161,103**	**5.0**

Data source: GDR, 2020

FOREST TRENDS

funding provided by

NICFI
Norway's International Climate and Forest Initiative

Norad