

Making sense of flexibility within value chains - Observations in the rubber sector in Southern China

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Abstract: *Volatile market and price developments pose risks for small-scale farmers who rely on production of one commodity as their main income source. Value chain development initiatives often promote vertical coordination like contracting and/or horizontal cooperation among actors in such a situation, in order to increase income security for smallholders and to ensure their participation in the chain. Analysing the regional value chain for rubber in Xishuangbanna, Southwest China, we show that under certain circumstances chain actors may have good reasons for maintaining spot market relationships and flexible transaction processes, and that smallholders are not always the weakest actor in a value chain. These circumstances are examined and theory-based explanations offered. Conclusions are drawn on possible implications for strategic farm management as well as for the initial analysis in value chain development programmes. Besides, the paper offers a rare insight into the functioning of rubber value chains, a topic insufficiently covered in scientific publications so far.*

Keywords: *value chains, smallholders, power, flexibility, embeddedness, China, rubber*

Introduction

Like several other agricultural commodities, natural rubber production is strongly influenced by volatile market and price developments. This poses risks for small-scale farmers who rely on rubber production as their main income source. This is the case, for example, for farmers in the Naban River Watershed National Nature Reserve (NRWNNR) in Xishuangbanna prefecture (XSBN), Yunnan province, Southwest China (Aenis et al., 2013).

Natural rubber is made from latex, the sap of the rubber tree (*Hevea brasiliensis*), and can be found in many products, mainly in tyres. China uses the vast majority of worldwide rubber production, approx. 38% in 2015 (ResearchInChina, 2016), while 6% are produced in China, approx. 800,000t (NBS, 2016; FAO, 2017). More than half of it is produced in Yunnan province (NBS, 2016). By 2010 the rubber area in XSBN extended to 424,000 ha (Chen et al. 2016).

Growth of rubber production has been enabled by provision of infrastructure, state subsidies, training, the development of locally adapted varieties and other research activities for rubber production. State farms had a major role here also after privatisation of their production activities in 1984. Their processing units continued in operation, while private processors entered the market. Today state-owned and private processing companies coexist on the level of primary processing. However, prices of rubber have fallen dramatically since 2012. This is due to multiple factors such as uncertainty of the world economy, lower demand than forecast, lower oil prices that lead to higher use of synthetic rubber (Thomas, 2016). There continues to be a production surplus on the world natural rubber market (FAO, 2017). The concern about the impact of this situation on smallholder rubber farmers is shared across countries (Thomas, 2016).

In 2014 61% of rubber area in China were in smallholdings, the share is even higher in other major producer countries like India, Indonesia and Malaysia (Thomas, 2016). In the NRWNNR rubber production has led to tremendous changes in social, economic and environmental systems. Strong economic growth came along with environmental and natural resource degradation as well as raising income disparities between rubber producing farm households and others, mainly in the highlands where rubber cannot be grown for climatic reasons (Aenis et al., 2013). By abandoning other crops and dedicating their whole land to

rubber, many farmers have become increasingly dependent on this sole cash crop (Wehner, 2011) and the volatile market situation it entails (Hammond et al., 2015). Since rubber trees reach harvesting age only after 7 years and its productive lifespan lasts until 35 years, farmers commit themselves for a long period. Rural food security is predicted to become more tenuous as a result (Xu et al., 2014). Climate and weather risks add to this vulnerability, in particular at higher altitude (Häuser et al., 2015).

Reliance on one or few crops for generating income is a situation shared with smallholders around the world. Associated strategies and risks are therefore worth attention of research, in particular as poor smallholders are often unable to buffer shocks and low price periods due to lack of resources.

In the case of rubber there are and have been many efforts to supporting income generation of small-scale farmers, particularly in the NRWNNR, and to making rubber production more sustainable, involving actors in government, administration and research. These efforts are mainly oriented towards land use changes such as introducing intercrops in rubber plantations (e.g. Min et al., 2017), forest restoration (Hammond et al., 2015), changing production practices or diversifying incomes of smallholders (Tang, 2013; Hammond et al., 2015; Hofmann-Souki et al., 2016). However, after experiencing the enormous economic success of rubber production in the last decades, farmers compare any land use change with the potential that rubber promises them, in spite of low rubber prices in recent years. There seem to be reasons beyond mere short-term profit or the lack of alternatives that lets farmers remain in a seemingly unfavourable situation of relying on a single crop. So far the role and situation of smallholders in rubber value chains is not well researched. There are few scientific publications on the functioning of rubber value chains in China or elsewhere.

Knowledge on these systems is necessary to understand the position of farmers and their possible leverage within the chains – the latter, in turn, determines the social and economic sustainability of their participation in the chain and thus their land use practices. A better understanding of prevalent coordination mechanisms in the sector may help actors within and around a value chain or cluster to formulate relevant strategies for development (Riedel, 2010). Furthermore, efforts to make rubber production and land use more sustainable place certain demands on farmers – these will need to be evaluated against the situation of producers in the rubber value chains, to better understand the chances for adoption of diversification or sustainability-related measures by farmers.

A first purpose of this article is therefore the provision of knowledge about the rubber-related socio-economic system that allows developing and assessing different targets for future development in an important rubber producing region.

Furthermore, the article aims at making a contribution to the understanding of smallholder reluctance to enter contractual relationships or upgrade in value chains – despite a highly volatile market situation that poses considerable income risks. Some characteristics of the XSBN rubber value chains apparently contradict the common understanding of global agricultural value chains that involve small-scale farmers, in particular regarding chain coordination and power relations. These merit a closer look so as to evaluate possible contributions to the general understanding of smallholder strategies in value chains. In recent years value chain development (VCD) approaches aim at integrating smallholders into global value chains or at strengthening the position of farmers in such chains through upgrading strategies (Donovan et al., 2015). These often involve increased coordination and integration within the chosen chains and greater specialisation of production (Trienekens, 2011). The approach is not uncontested (Seville et al., 2011; Ponte and Ewert, 2009; Salazar, 2012; Currie et al., 2014). On a more theoretical level, flexible (spot) market organisation has been viewed as the “null hypothesis” that is gradually overcome by more hierarchical forms of coordination (Williamson, 1991). As a consequence, markets were neglected as an object of social inquiry (Krippner, 2001; Bair, 2008). A second purpose of this article is therefore to make a case for re-examining smallholder strategies in international value chains and possible conditions that may favour flexibility over integration.

Based on the elaboration above the following research questions have been formulated for this article:

1. Which are major characteristics of value chains for rubber originating in the NRWNNR/XSBN, in particular regarding the position of smallholders in this system?
2. How may strategies of upstream actors be explained which aim at maintaining flexible and spot-market relationships even if those are associated with high transaction costs?

Although we recognise the network character of relationships in the XSBN rubber sector, we chose the value chain as analytical focus, because it represents the main line and mechanism of functioning. The value chain approach is used to analyse the structure and functional distribution of rubber production, trade and processing in XSBN. *Value chain analysis* (VCA) also helps to understand how the chain is coordinated. The underlying theoretical pillars for VCA are governance, power and institutions (Sturgeon, 2008a). Thus VCA sheds light on organisational aspects of this economy (Gereffi, 1994). According to Ponte and Gibbon (2008) the value chain perspective allows to understand the trend towards vertical coordination among firms. The tacit coordination of markets seems to be replaced in the globalised economy with 'explicit coordination' through direct information exchange (or further integration) between companies of a chain (Humphrey and Memedovic, 2006). We draw from the Global Value Chain (GVC) approach developed by Gereffi et al. (2005) by emphasising a micro-level analysis of relationships between actors in the chain to explain VC coordination. Although we examine a regional segment only and not all rubber reaches international markets we consider that the industry is inherently a global one.

Governance is defined as forms and mechanisms of coordinating relationships of autonomous but interdependent actors (Benz, 2004) and focusses on networks in a general sense (Riedel, 2010). Seen as social systems with evolving patterns of interaction, Benz et al. (2007) distinguish *governance form* (i.e. structure of interactions built through repeated collaboration and formal rules) and *governance mechanisms*, i.e. cause-effect-processes that result from the system's institutional structure and the action motives of actors. The functioning of the social system hence is determined by actors' capacity to adapt and coordinate their actions and goals between each other.

Institutions are defined as sets of rules that indicate what a person must or may do, or not do, supported by collective action (Commons, 1931). Institutions are valuable for reducing uncertainties and thus risk (North, 1990).

In the context of value chains, the concept of governance is used to describe the inter-firm relationships and institutional mechanisms for non-market coordination of activities in the chain (Humphrey and Schmitz, 2001). Between the poles of market coordination and complete vertical integration, several governance forms involve different degrees of cooperation, formal and informal institutions.

Transaction economics as central pillar of new institutional economics considers economic and social (inter)action as transactions that entail various institutional arrangements (Preisendörfer, 2008:47). According to Williamson (1979) costs are incurred for any transaction, and these costs increase if uncertainty and complexity of a transaction is high, which requires combat strategies. Following Granovetter (1985 and 1990), the relational and structural *embeddedness* of economic action, its outcomes and institutions is considered here, too.

Linked to the governance concept, analysis of power relations and their bases are useful for understanding the functioning of rubber VCs. In his power dependency theory Emerson (1962) defines *power* as a property of social relations, i.e. power resides in the dependency of an actor from others. This means that power can emerge from dependency or independency which, in turn, result from need of or control over resources. In VC literature power is studied mainly in the context of lead firms and their suppliers, i.e. power asymmetries between actors along the chain (Humphrey and Memedovic, 2006). The difficulty for research is that measuring power from an external viewpoint would not always

provide suitable clues, because actors may have different perceptions of their own power in relation to that of related actors, just as they evaluate risks differently – and they act according to their own perceptions (Sutcliffe et al. 1998). It is necessary therefore to understand power relations from the perspective of actors themselves.

Methodology and delimitation

Description of research area and population

XSBN is the southernmost prefecture of Yunnan province, bordering PDR Laos and Myanmar and linked with Thailand through the Mekong River. It has an ‘autonomous’ status because of its many ethnic minority groups, which means that decision-making is more decentralised here (Hammond et al., 2015). There are 13 different ethnic minorities, and XSBN is known as a tropical biodiversity hotspot. The terrain is mountainous, and while infrastructure is generally good, villages in the higher elevations are less connected and less wealthy on average, while still more un-degraded forest can be found there (Hammond et al., 2015). 70% of the population live in rural areas, with agriculture as main income source. Traditional farming involved tea agroforestry and rice paddy, among others, and swidden agriculture had been common (Tang, 2013). Tea is still grown in almost all households on high elevations. Rubber cultivation is possible and widespread in the lower elevations and becomes very risky and little profitable above 900m altitude, while further damaging biodiversity, water and soil quality (Häuser et al., 2015). Both women and men are involved in rubber farming, whereas women seldom take up off-farm employment which is relatively popular among young people. Further details on the social, economic and environmental characteristics of XSBN may be found in Hammond (2015); Tang (2013); Aenis et al. (2013); as well as Häuser et al. (2015).

Located in the central north of XSBN and in the catchment area of the Naban river, the NRWNNR is a reserve on 266,6km² following UNESCO’s “Man and Biosphere” network: It combines environmental protection with livelihood areas for the local population (Wehner, 2011). It consists of mountainous terrain from 539m to 2304m asl. Forest cover had been reduced to 50% by 2003. Most villages are located in the reserve’s experimental zone where agricultural activities are allowed. However it is not permitted to enlarge the rubber area or plant rubber on steep slopes, which places restrictions on production conditions for NRWNNR farmers as compared to the rest of XSBN.

Differences in the socio-economic situation relate to altitude of farms/villages (infrastructure, distance to market, climate for rubber production), and dividing lines therefore exist also between ethnic groups, depending on the area where they live, as found in earlier studies (Aenis et al., 2013; Hammond, 2015). Wehner (2011) confirms a close link between ethnic group and traditional land use patterns, while Tang (2013) attributes differences between villages also to different policies, capabilities and administrative interventions.

Materials and methods

As suitable for value chain analyses with a focus on actor relationships, and due to their cultural fit, qualitative guideline-based expert interviews have been used as main method of data collection. They build on a baseline study conducted earlier, which constituted a stakeholder analysis of rubber production in the NRWNNR (Aenis et al., 2013), as well as on a study on farmers’ willingness to accept or self-direct land use changes (Aenis et al., 2018).

For the present chain study 44 expert interviews had been conducted with actors of the regional rubber sector: two providers of agricultural inputs, 19 rubber farmers in several villages on different altitudes in NRWNNR – among them five village heads -, three village youth, four middlemen and seven rubber processors, as well as two representatives of the local state farm and eight of relevant governmental administrative entities. The latter include the Environmental Bureau, Forest Bureau, Bio-Industry Development Bureau, NRWNNR (nature reserve) Bureau and further more.

No previous studies were available regarding the functioning of rubber VCs, giving this research an explorative character. Wherever necessary interview transcripts of the two previous studies have been used for triangulation. Data collection was restricted to the NRWNNR region and Jinghong city, as stipulated by the research permit for the project. Hence it was not possible to interview actors further down the value chain who are located outside the research area. This limits data collection to the segment of the value chain leading up to the rubber processing stage. However this is seen as acceptable for the given research objectives. The investigation focuses on VCs for rubber originating in the NRWNNR although downstream actors also receive raw material from elsewhere.

For further triangulation preliminary results were presented and discussed with actor representatives at a stakeholder workshop hosted by NRWNNRB, so that their feedback could be incorporated into the analysis.

Results and discussion

Description of rubber value chains

Functional differentiation between actors

Value chains of rubber originating from the study region differ in complexity. Figure 1 depicts the different tasks which actors fulfil along the chain up to the sale to a manufacturer of products and components (e.g. tyres). There are some variations, in particular between value chains for latex (fresh liquid rubber sap - farmers sell the liquid to processors or middlemen where it is solidified) and solid rubber (farmers themselves solidify and store the latex). Based on the data generated, four basic value chain models emerged. In the latex value chain model the tasks can be fulfilled by only two actors (a farmer and a processor), but there could be more actors involved. The other three models represent chain structures for solid rubber. In the "long value chain model" the tasks are distributed among many actors, with many transactions between them. Some tasks and transactions are eliminated in the "direct sales model", while all tasks are integrated within one company in the "Laoban model" ("Businessmen model"). The latter is found outside NRWNNR only. Intermediate forms between these distribution models exist, too, and actors may switch between them or be part of different value chains at the same time.

Actors, product flows and transformation in rubber value chains

As shown above, until the selling to manufacturers of rubber products or parts the number of actors involved in the value chains may vary considerably, with value addition done by up to seven actors in longer value chains. Flow and transformation of products between the actors in the rubber value chains is depicted in Figure 2 below.

Farmers sell either liquid latex directly to middlemen or factories, or they solidify it and sell rubber mats within the following months. Selling latex is possible if collection points are close-by, as latex needs immediate processing. Prices are defined depending on measured dry rubber content (around 20% of raw latex). As dry rubber content may differ between farmers and harvests, each farmer sells rubber separately. The buyer then measures the rubber content per individual delivery and determines the price.

Farmers can store solidified rubber mats on-farm and then sell them at their own convenience to middlemen at nearby collecting points, or to factories directly. Pricing of rubber depends on quality grades (four in total) that largely correspond to the national industry standard, SCR. However, price differences between grades are judged to be small. They can be influenced during harvest and storage. Factories do the grading *after* processing each individual delivery per farmer, so that the price is not determined immediately upon delivery to the factory gate. Farmers have to either wait for several hours and/or return a few days later to finalise the transactions. This seems to be a special technical feature of rubber production in XSBN, and it has important implications for organisation and governance of the chains. When farmers sell to middlemen, the latter

grades the quality based on visual appearance, weighs the mats and pays to farmers directly.

After processing at the factories, processors sell rubber in three different forms to their customers: Latex concentrates, Compound Rubber, and Standard Rubber, the latter mainly as blocs rather than sheets or crepes. The national rubber standard applies as well as a standard for quality testing. Dust content and plasticity are most important quality criteria, with uniformity being decisive for buyers. To this end, processors may have different production lines for different customer demands. The processed rubber is then stored in Kunming, the closest transportation hub.

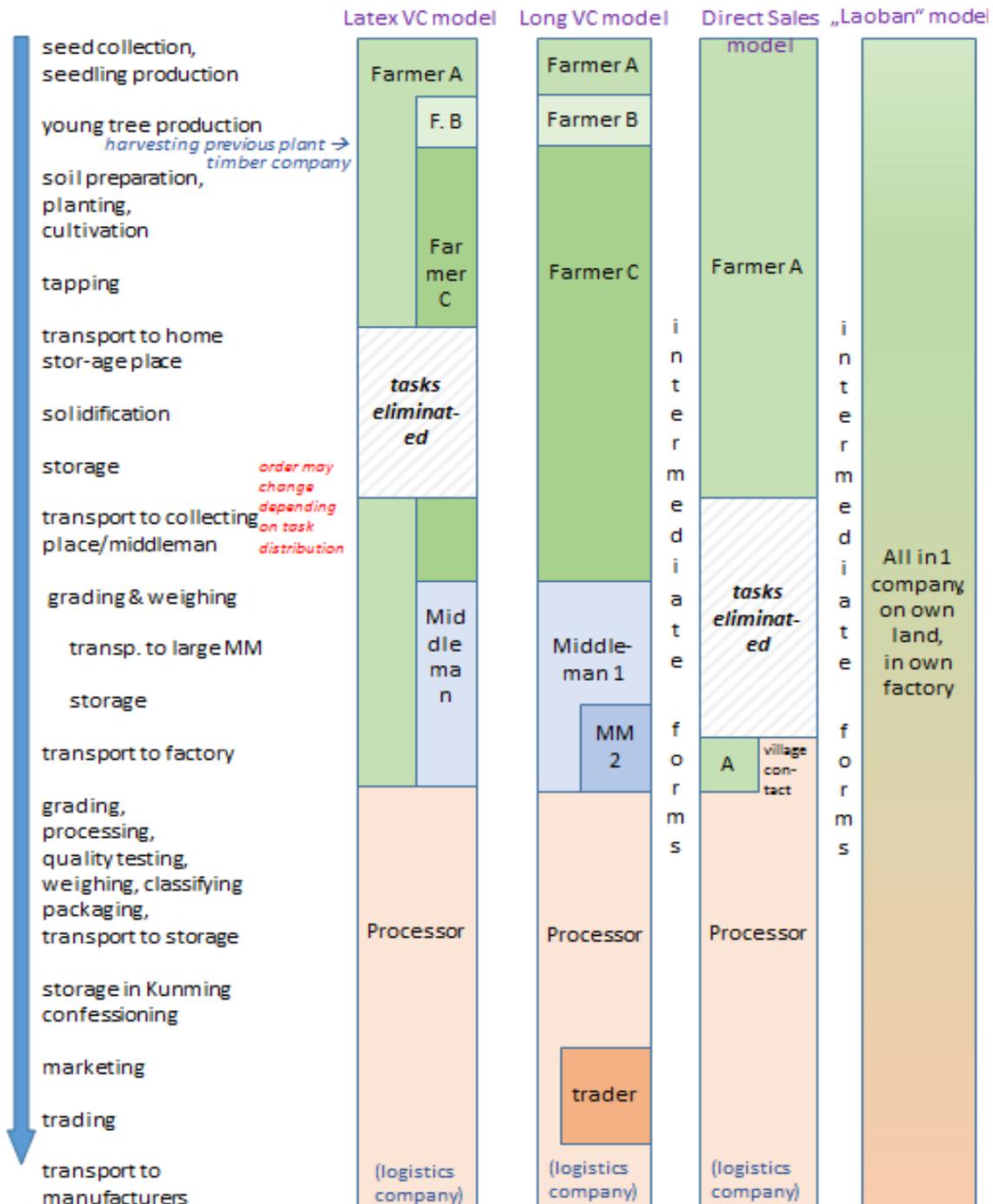


Figure 1: Functional distribution along four different models of rubber value chains. Own representation.

Customers are located in different parts of China as well as in Japan, Australia, Southeast Asia and overseas. Transportation cost is a frequently reported problem, as the region is far away from (lower-cost) sea transport, leaving them at a disadvantage to competitors in neighbouring countries. Main buyers for XSBN processors are tyre companies producing automobile or aerospace tyres. Further customers are manufacturers of, for example, damping products or sealing elements, rubber hoses or conveyors. Trading companies form another customer type – those, in turn, sell to tyre manufacturers or use the rubber for speculation at stock exchanges. Futures trading at Singapore, Japan or Shanghai stock exchange is reportedly practiced by certain processors themselves as well. However due to the higher demands in quality and quantity this form of marketing can be managed by fewer processors only.

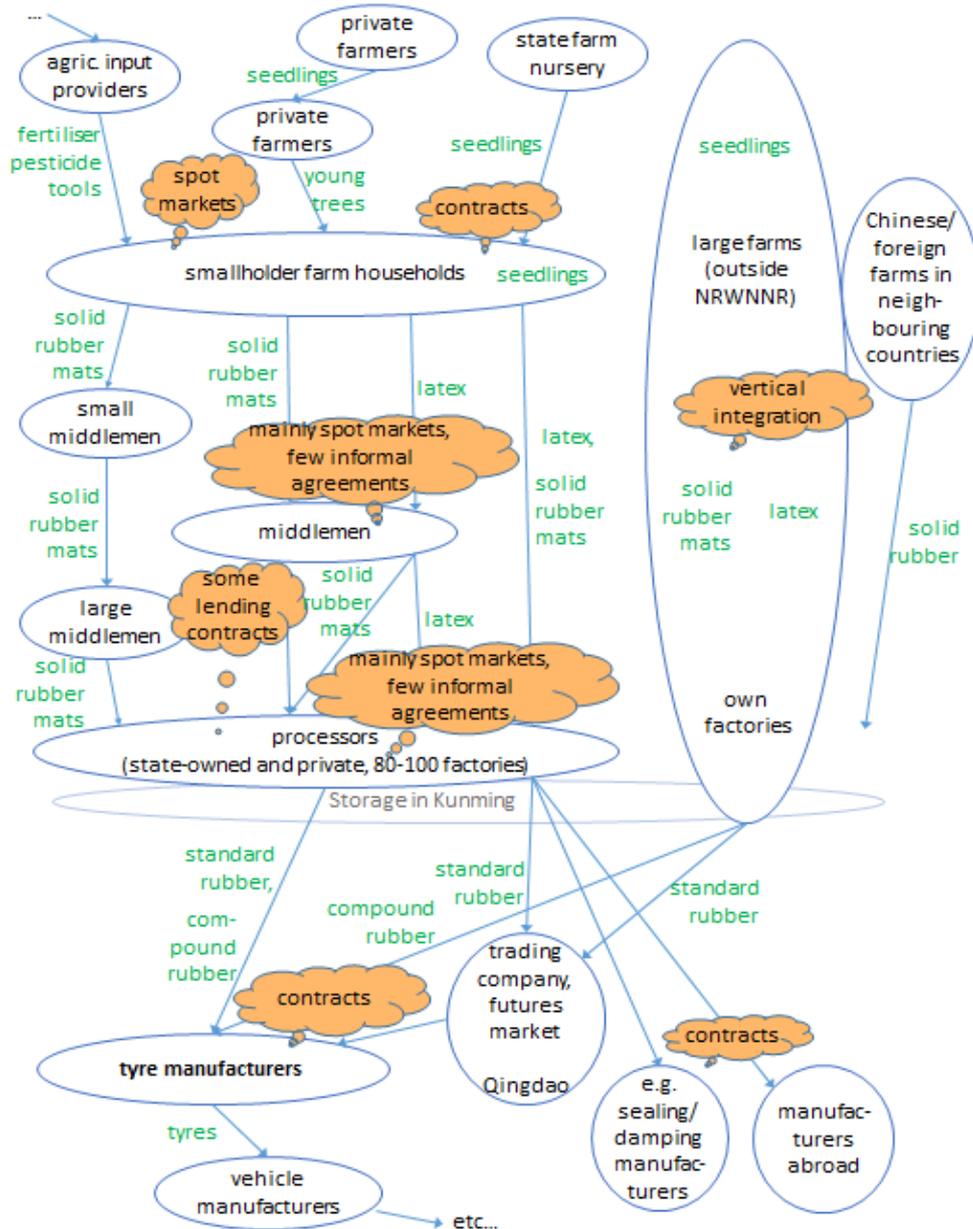


Figure 2: Map of value chains for rubber produced in XSBN: Actor types, product flows and governance forms. Own compilation.

Coordination and business environment

In our case institutions like governmental regulations, industry standards, bilateral agreements, and internal company management contribute to governance and coordination mechanisms of the sector and have therefore strong influence on the nature of relationships

between chain actors, in addition to price dynamics, the social context and informal institutions.

Rubber had been declared by the Chinese government as being of national priority. This means that the national government has retained major decision-making competence on matters affecting the rubber industry, including rubber farming. Governmental bodies on provincial and prefecture level implement national rubber-related policies. However, numerous governmental bureaus and local administrations are concerned with varying, sometimes overlapping responsibilities regarding rubber production and processing, land use etc. (Wang et al., 2012). Hammond et al. (2015) provide for further explanations on the governmental system in XSBN and linkages with actors in the rubber sector.

Governmental regulations relevant to the rubber sector in XSBN include planning and programming, environmental regulations, laws on privatisation and reform, tariffs on rubber imports, and inter-governmental agreements which lead to national regulations. It appears that privatisation of state farms, following a regulation of 1984, has had the strongest impact on XSBN's rubber sector in the last decades. Since then state farm managers do not have any directive role in rubber production on state farm land, but individual farmers manage their own parcel, although often considering advice from state farms. In the case of the nature reserve and processing facilities, environmental legislation has a steering function in so far as rubber plantation area is curbed, rubber cultivation is prohibited in sensitive areas (hilltops, slopes) and certain rules are set for e.g. wastewater treatment in the factories (all of which are located outside the nature reserve).

Industry standards are central for trading rubber products: The national rubber standard GB/T 8081-2008 closely follows internationally established standards like Technically Specified Rubber (ISO norms). However also other standards are relevant, such as: standards of stock exchange companies for trading of rubber futures. Sellers normally need to obtain certification on all industry standards for their products. However, in the case of raw rubber and latex, buyers do the grading, as explained above. This is performed more or less strictly, depending on the price level and supply situation. It was reported that large processors may influence the setting of rules and standards in China, but have no influence on the market at manufacturing level.

Interestingly, there is a variety of flexible relationships between actors in the upper part of the rubber chains in particular, whereas contracts dominate the relationships in the lower parts of the chain, as visualised in Figure 2. Spot markets dominate the upper parts of the chains. Contracts in this part of the chain are only made in case a production factor is missing: land, collection place, equipment or money. In the case this is borrowed from a certain buyer the produce is sold to that buyer in exchange. In the lower part of the chains contracts are made between actors. Table 1 shows the types of bilateral agreements that shape the relationships between actors along the chain.

Some processors engage in futures trading of their rubber, thereby diversifying their sales channels. Here brokers (traders in China, stock exchange companies abroad) have an important coordination function. They help processors finding buyers and selling their rubber at pre-set conditions. However, requirements reportedly are stricter in this channel, and this solution does not diminish the sourcing problem.

On each chain level there exist specific conditions for participation in the chain. Many constitute investments or conditions relevant for any type of agricultural value chain, e.g. transportation and knowledge, or assets that can be used for other purposes, too. For farmers, the most important specific investment is the land planted with rubber trees, in particular as it takes up to eight years until the latex may be harvested for the first time. Middlemen have to buy or rent expensive equipment to measure rubber content and need to have substantial amounts of cash to pay farmers, well before they themselves are paid by their buyers. Processors' investments are the most specific, as the machinery cannot be used for other purposes. Some have quality specific production lines for different customers. This may explain the prevalence of contracts at this level.

Table 1: Bilateral agreements supporting rubber value chains. Own compilation

Relationship	Bilateral agreements found
Between rubber farmers and land owners	Leasing land to friends or family, the farmer either makes yearly payment or grows rubber trees for the owner who then receives the revenue from rubber yield of these trees. Rather common practice Leasing trees from state farm – two models of 18-year contracts: a) State farm provides seedlings and fertiliser for free and pay farmers for raising them. When tapping age is reached farmers and state farm share revenues from rubber sales (70:30%). b) State farm sells seedlings to farmers, farmers pay all expenses of production and get all revenues until contract expires. Allow other farmer to grow coffee under young rubber trees against expected shade (less weed undergrowth), after 10 years coffee shrubs belong to land owner. Not common
Between state farm and middlemen	Middlemen rent storehouse for rubber from state farm against monthly payment
Between farmers and tappers	Tappers receive a 30-40% share of revenue from rubber sales, with or without written contract. Common practice
Between farmers and middlemen	Middlemen lend money to farmers who then sell to them.
Between farmers and factories	Factories lend money, pick up rubber from village, sell inputs at low price – farmers sell to them in return. Non-binding oral agreements on better prices for larger quantities. Rather uncommon
Between middlemen and factories	Lending equipment to middlemen – middlemen sell to them, via contract. Mainly if middlemen are new in business Slightly better price for selling large amounts. Rather uncommon
Between factories and their customers	Yearly agreements based on long-term framework contracts. Common practice

Focal points for further study

Certain observations from the description above point towards specific phenomena worth closer examination:

- a) There is a variety of actors on each chain level, and no strong lead actor that forms a bottleneck and shapes chain governance. Coordination is obviously performed by other means.
- b) Smallholders seem to be relatively well-positioned in the present system. Although they complain about low overall market prices they cannot be regarded as the weakest actor in the chain.
- c) Flexibility is highly valued by all chain actors and is institutionally supported. Related transaction costs are borne and seem to have a function in the socio-economic system.

In the following sections these observations are analysed and discussed in detail.

Forms of coordination in chains without a clear lead firm

Global commodity chain (GCC) and GVC literature commonly describes chains dominated by a lead firm that shape governance mechanisms and partly governance structures. Small-scale actors like family farmers are said to be in a weaker position against their buyers in these chains (Schmitz 2003, Gereffi et al. 2001, Sturgeon 2008b, Trienekens 2011), also because of the bottleneck that forms when many suppliers face a small number of buyers.

Strong governance mechanisms are used to coordinate such chains, and risks are attenuated by relationships within the chain (Sturgeon, 2008b).

In our case, however, there are many actors on each chain level: Farmers in all three chain models prevalent in NRWNNR may sell to different middlemen or to several factories directly, middlemen have the choice between selling to larger middlemen or to factories, and these processing factories, in turn, sell to different customers with different demands, not only because of the different product qualities obtained but also because there are variable uses for their rubber products in several industries – national and international. It appears therefore that no clear lead firm may be identified, even though there are hints of an oligopolistic tendency among a few large processors. It is quite obvious that governance in the three chain models is not prescribed or dominated by any actor. As shown above farmers and middlemen have several marketing options, it is common to switch between buyers and chain models. Spot market organisation prevails. Processors, in turn, often have contracts with several buyers, with limited options to sell produce in auction markets. As a result rubber processors are in a situation where they are contractually bound with their customers, but cannot secure their supply through contracts.

Factors influencing governance structure

According to Gereffi et al. (2005) the governance types found in a chain are constituted by three main factors: the complexity of information and knowledge to be transferred in a transaction, the codifiability of this information, and the capabilities of suppliers in relation to the requirements of the transaction. Applied to our case we find that international industry and government standards – e.g. on quality grades and environmental protection - constitute a central coordination mechanism and point of reference for all actors in the XSBN rubber chains. Which quality grade processors may produce depends to a very large extent on the raw material received, so that the grading done for raw material is closely related to the TSR specifications, too, albeit in a simplified form (rubber content, colour, dirt inclusion). Product specifications are thus well codified (Gereffi et al. 2005) and easily understood by all actors in the chain. Results also show that suppliers find the standards easy to follow. Thanks to the capacity building efforts of state farms and extension in the past and informal learning among producers, most farmers have the knowledge necessary for producing different qualities of raw rubber. Through state support they also have the infrastructure and facilities for selling both latex and solidified rubber; solidification and storage are less complex than postharvest handling of most other crops. Capabilities of primary producers (Gereffi et al. 2005) are thus sufficiently developed, and access to inputs is said to be unproblematic.

This does not mean, however, that farmers always make the effort to achieve high quality grades, as price differences are seen as negligible. They decide in which form to sell their produce and at which point in time. Through regular inquiries about offers of different buyers they also decide about the sales price to a certain extent. The same applies to most middlemen. In sum, easily codified transactions, simple product specifications and relatively high capability of the supply base are factors that make market coordination the likely form of governance, as shown within the framework of Gereffi et al. (2005). As maintained by Trienekens (2011) the standards help to reduce coordination costs here. These favourable conditions also explain why market coordination prevails here while in comparable situations in Africa Swinnen et al. (2007) found interlinked business models (with farmer-buyer contracts combining product exchange with input, credit and extension provision) to be more successful for such traditional export commodities.

The picture looks different for the onward links: Processors make contracts with their buyers which allows investing in product differentiation and helps reduce transaction costs at this level. Specifications are codified and little complex, and the relationship fulfils some characteristics of modular chains (Gereffi et al. (2005), but switching trade partners is still easy. Asset specificity exists only in cases where processors invest in specific production lines for different target products. However, processors' capability to fulfil expectations of buyers strongly depends on the raw material supplied, which puts some risk on contract fulfilment. The setting puts processors in a difficult position: They have to comply with the downstream

contracts, but cannot exactly foresee how much and which quality of raw material they will be able to source. Interestingly, vertically integrated companies are found outside the nature reserve only. Governmental regulations, in turn, have the potential to even force processors to close down, as it happened in the past with smaller private companies following pollution reduction laws.

Embeddedness of rubber value chains

Informal institutions like social and cultural norms have a role as well, as elaborated below. Within the Chinese system of *guanxi* (connections) people are closely tied in relationship types classified as family, friendship or political (Wong 2007), and Chinese firms integrate into networks of social and business webs (Pearce and Robinson 2000). According to Wong (2007) *guanxi* is also the basis for evolving governance structures in business by setting the rules for communication between individuals and organisation representatives on different levels.

Overall development of the sector is coordinated by semi-formal networks of private and public actors: New rubber varieties and rubber production techniques origin from these networks; state farms are therefore an important source of information and do capacity-building for farmers. Similarly, advances in processing technology often come from close and long-standing cooperation between specific processors, bureaus and research institutions. While there is no overall lead firm in rubber value chains in the region, the networks mentioned here certainly fulfil a leading role in in the sector by giving major impulses for its technological development (see Tang, 2013). Historic embeddedness has an important influence here. Dating from the time before privatisation of state farms and companies, well-established relationships between both organisations and people exist, both formally and informally. This can now be observed, for example, in the development of the rubber seed processing sector, according to interviewees. Ponte (2014) talks of “multipolar governance” in similar constellations in the biofuel sector. Tang (2013) has identified state farms, innovative “lead” farmers, input suppliers, processors and individual businessmen as important agents in technology transfer. The role of local government is changing from a supplier of technology to brokerage between farmers/processors and markets, although – unlike for other crops like vegetables- they do not promote contracts for rubber supply (ibid). The above-mentioned mechanisms show that regional cluster effects may certainly be observed here, and cluster theory may therefore have explanatory value with an additional perspective, as shown e.g. by Riedel (2010). However, due to shortage of space that line is not followed in this paper.

The position of small-scale farmers – not the weakest link in the chain

GCC literature describes how standards and grading systems as dominant institutions in globalised chains shift power away from small producers (Sturgeon, 2008b) who normally do not have any influence on the creation of such standards and the institutional mechanisms with which they are enforced. This is why VCD programmes often focus on increasing the capacities of and creating better conditions for the “inclusion” of smallholders in GVCs, or to improve their position in the chain through upgrading strategies. Increasing capabilities of suppliers and “de-commoditization” (Fitter and Kaplinsky, 2001) is said to lead to more balanced bargaining power (Trienekens, 2011). Partnerships or contractual relationships (or so-called “business models”) are seen as the main tools for such objectives (Vellema et al., 2013; Currle et al., 2014) – an increase in explicit coordination (Gereffi et al., 2005) is promoted and actively pursued. Such strategies lead farmers away from market-based sales, with the promise of higher income security and greater capacities for following future trends in demand, in particular the anticipated raise of product and process standards.

Following Gereffi et al. (2005), stronger vertical coordination entails increased power discrepancy, though. Power, the way it is executed (its effects) and the sources of power are particularly relevant variables in the understanding of GVCs (Sturgeon, 2008a) and are of explanatory value in our case, too.

As we have seen above, most farmers in the NRWNNR are confident and proactive agents in the regional rubber value chains. With the exception of indebted or poor and inexperienced rubber farmers in particular in the more isolated higher elevations, these producers actively negotiate marketing conditions, including the selection of buyers, timing of sales and, taking advantage of the competition among middlemen and factories, even influence prices to a limited extent by forcing them to accept lower qualities in price categories for higher qualities, as interviewees mentioned repeatedly. With their choices they also influence certain rules and procedures for transactions in the chain, such as processing and price calculation for individual lots.

It is obvious that they can hardly be regarded as weak or disadvantaged chain actors. Examining power relations and sources of power sheds light on some reasons for this phenomenon. Interestingly, actors' perceptions of relative power differed. Farmers, middlemen, certain large processors, or upstream actors like brokers and tyre manufacturers are named alternately as having the most power in the chain. All stated, however, that other actor types had more power than they themselves had. Further analysis shows a diversified picture: Factors influencing the relative power of each actor type is detailed in Figure 3 below. For reasons of space this is discussed with a focus on farmers' sources of power in particular. Crop-specific factors, the role of state and local institutions, general competitiveness of smallholdings and VC-specific factors all contribute to explaining the status of small-scale farmers in these rubber VCs.

	Farmers	Middlemen (MM)	Processors general	Former state farms/processors	Downstream actors
Sources of power (with variations within the actor groups)	<ul style="list-style-type: none"> Regional undersupply (over-capacity of factories, competition among middlemen) Wide choice of buyers Good marketing skills (knowledge of prices and buyers' demands, confidence, actively seeking choices) Non-standardised product (latex) Storable product (easy to solidify) Own transportation possible Possibility to postpone tapping without loss of total yield per tree Alternative livelihood strategies 	<ul style="list-style-type: none"> Good relationship with factories, supply high volumes Village native MM are trusted Reputation Able to grade rubber and latex of farmers (rel. high cost of measuring equipment) Convenient location of collecting places Financial buffer: May lend money to farmers, binding contract Financial buffer and high storage capacity: can wait 	<ul style="list-style-type: none"> Pricing: Able to grade rubber and latex of suppliers Capital: lend equipment to MM, binding contract Knowledge of future production volumes Better knowledge of market development (prices, conditions) Oligopoly: Communication of large actors 	<ul style="list-style-type: none"> Capital basis/credibility Up-to-date know-how Easier access to policy makers and administration, established relationships 	<ul style="list-style-type: none"> Oversupply in global market May use rubber substitutes
Limitations of power	<ul style="list-style-type: none"> Limited availability of workers and land trees planted = asset specificity (specific investment) Transportation costs increase with distance Reference price set by broker and large processor oligopoly/world market Mistrust, transaction costs for joint action Little ability to verify grading decisions Limited capability for investigating and implementing diversification options 	<ul style="list-style-type: none"> Factories could source solid rubber directly from farmers Farmers have large choice of sales points and buyers Product quality depends on farmers High rubber prices require enormous financial buffer 	<ul style="list-style-type: none"> Pricing of competitors Downstream actors define demand, farmers define basic quality Undersupply/high cost of sourcing abroad High asset specificity: specific investments and know-how, little access to high-end markets Large share of fixed costs Low trust by farmers 	<ul style="list-style-type: none"> Variety of governmental organisations influence policy-making and implementation Dependent on government decisions Historical legacy, expectations from various societal actors 	<ul style="list-style-type: none"> Supply volatility

Figure 3: Factors influencing power of actors in the rubber chains. Own compilation

Some of the factors giving a relative advantage of rubber to smallholders lie in the characteristics of the crop: low initial investment cost (apart from dedicating land to rubber for several years before gaining income, as is typical for perennials), few crop specific inputs, relatively low production know-how needed, simple postharvest handling and storage (Bissonnette and De Koninck 2017, McCarthy 2010) – factors that make rubber accessible also without requiring horizontal cooperation besides information exchange. The crop also allows to switch to a low-input low-output regime (Bissonnette and De Koninck 2017) in times of low rubber price – a strategy frequently followed in the NRWNNR. Further factors have been created by the state, like road and telecommunications infrastructure and the National

Rubber Standard as common reference, as well as rubber related policies providing initial training and good-quality seedlings through state farms and the distribution of trees and land to small farmers during privatisation of state farms. McCarthy (2010) as well as Bissonnette and De Koninck (2017) emphasise the importance of such state action for success of smallholder production and show consequences of inclusion and exclusion of farmers, thus confirming our findings. The latter also elaborate competitive advantages of smallholder farming systems in comparison to large-scale plantations: Their versatility and flexibility to adapt livelihood strategies to changing market conditions make them suitable producers in a volatile rubber market, while large-scale plantations have high management and labour costs that may offset economies of scale. This may explain why smallholders are able to grow plantation crops like rubber competitively even if they do not receive any direct benefits that are often granted to large estates (Bissonnette and De Koninck 2017). They reason that smallholder rubber production is efficient *if measures for success are capital and labour investment*, even though rubber yields vary according to local conditions and capacities (ibid). It is considered that farmers retain alternative on-farm and off-farm livelihoods options in parallel (ibid; Aenis et al. 2018).

Authors like Falkowski et al. (2017) distinguish a multitude of factors that may increase farmers' bargaining power: high volumes produced/large farm size, low distance to market, high-quality produce, personal contacts, long-term relationships, negotiation skills, good performance relative to other farmers, distribution of property rights, mutual loyalty, asset specificity, contract enforcement, distribution of risk, alternative livelihood options *and self-perceived strength*. As shown here some but not all of these are or may be employed by our rubber farmers in transaction situations.

However, our findings suggest that there are considerable differences between farm families and between villages regarding these factors, that have important consequences on the social and economic status of farmers. Visible and increasing differences in livelihoods and village structures have been documented as a result (Aenis et al. 2013, Aenis et al. 2018, Tang 2013).

Cramb et al. (2016), Bissonnette and De Koninck (2017) as well as McCarthy (2010) argue that the effects of such differences in capacities of farms and farm families are influenced by local institutions, too. Social embeddedness may hence partly explain differences in income disparities resulting from the adoption of cash crops like rubber. In the NRWNNR strong informal social networks as well as formal institutions like village committees and the village heads support knowledge exchange and provide financial assistance for investments, as Table 1 shows. These institutions, and also the flow of information, usually run along ethnic lines (Aenis et al. 2013, Hammond et al. 2015). An important institutional condition is that land always belongs to the communities even if it has been distributed for use to independent farmers (Tang 2013). This means that land may only be rented, never sold to any local or external investor. Although land rental is frequent (Aenis et al. 2013, 2018), this regulation prevents the creation of a new class of landless labourers (Huang et al. 2012) as found elsewhere in Southeast Asia following the surge of plantation crops like oil palm (McCarthy 2010) and as a result of partnership schemes (Bissonnette and De Koninck 2017, Cramb et al. 2016). Interviews show that rental contracts in the NRWNNR are usually discussed by farmers with the village head, and the rental of community land is discussed and decided in community meetings (Aenis et al. 2018). These local institutions apparently help stabilising the resource base in the communities at least to a certain degree.

Other sources of power are specific to the value chain, with the excess processing capacity as the most important factor. This regional undersupply and the high number of factories in the area give producers much room for decision-making. Moreover, farmers' knowledge and active management of marketing information and trade relationships – in short, high marketing competence – add considerably to their bargaining power in this respect. This is

effective even though explicit horizontal cooperation or collective action is kept to a minimum by farmers, as explained later.

Other chain actors have their own sources of power, as shown in Figure 3. GVC theory tends to neglect the fact that power is never completely concentrated in one actor (Riedel, 2010). Sources for and levels of countervailing power of other chain actors may explain governance arrangements, as countervailing power gives room for negotiation among actors. From the viewpoint of game theory bargaining power is influenced, among others, by the social capital of actors (including reputation), the presence or absence of alternatives and dependencies as well as the time aspect, e.g. the possibility to await an outcome (Dixit and Nalebuff 1997). In accordance with Avelino (2015) the different types of power do not always limit each other's bargaining space, as the sources of power differ. Still, some exemplary direct relations are shown using arrows.

Noticable effects of the power structure in the sector are difficulties to enforce quality norms, competition over raw rubber supply combined with market consolidation on processors' level, high autonomy of farmers, complicated processing and transaction procedures, lower profit margins for all actors in a shrunken market due to low overall price levels. We observe the absurd situation that oversupply on the world market and related low prices cause undersupply and weakened processors on the local level. This results in a relatively even distribution of power and room for negotiation along the chain.

The high value of flexibility

As can be seen from the description of value chain relationships and coordination mechanisms at each level, various types of transaction costs are incurred, of which some are rather specific to the regional rubber sector.

Having said that, there usually are reasons why actors in the chain accept high transaction costs and remain independent, both vertically and horizontally.

In order to explain the meaning of flexibility to chain actors it helps to examine the sources of uncertainty: In sum, actors are faced with various types of uncertainty: World market price and demand volatility, supply risks (for processors), policy intervention on different levels, opportunism, and, for farmers, also weather risks, new options arising and uncertain farm succession prospects.

Given the volatile market with frequent price changes processors would risk cash flow problems in case they agreed on a relatively high price for raw material supplied and the world market price is lowered later on. All buyers also consider the risk of not collecting the agreed quantities and qualities of rubber, a symptom of undersupply. Factories prefer giving less binding incentives, except for the lending contracts mentioned in Table 1. Respondents were reluctant to discuss compliance issues, though. According to Gray et al. (2006) the development of more closely coordinated supply chains created new contractual or relationship risks for farmers that are not typically experienced in commodity-based agriculture. Contract failure is likely where there are many competing buyers and where commodities are easily storable and transportable (Swinnen et al. 2006), as in our case.

Farmers and middlemen, in turn, are reluctant to make contracts because they might lose out on other opportunities arising. They prefer freedom of choice in a volatile market, where prices and trading conditions may be easily compared via telephone enquiries.

As explained in the previous chapter stronger vertical coordination would entail increased power discrepancy to the disadvantage of farmers. Maintaining spot markets therefore helps levelling power among chain actors. As long as factories run below their full capacity and compete with each other for rubber supply, independency is a source of countervailing power for farmers and middlemen. After all, asset specificity is relatively low in this part of the sector, so that making contracts to secure pay-off for specific investments (Gierl 2000) is not very important for value chain actors. Neither do input, credit and extension provision need to be

secured via interlinked delivery contracts as observed e.g. by Swinnen et al. (2006) for other traditional export crops.

Planning security is apparently not valued as highly as the flexibility in responding to the chances and risks mentioned here above. This conforms to the argument of Porter (1980) as well as Harrigan (1985) that environmental uncertainty would discourage vertical coordination as it implies strategic inflexibility. If – as in our case – uncertainty is perceived as high, then flexibility has a high value. Jones and Bouncken (2008) argue from the perspective of organisation theory that network-type structures have advantages over (vertical) integration in situations where it is desirable to quickly respond to changes. Hierarchical organisational models are seen as suitable for more stable environments.

If therefore individual freedom of decision-making is highly valued, cooperation is perceived as a restriction and, therefore, not a good strategy. Refraining from cooperation is the rational choice, as a consequence. But what are alternative solutions found?

Alternative strategies to manage uncertainty and transaction costs of non-cooperation

Price risks are attained directly at producer level: Contracts with hired tapping workers or landlords (if land is let) are made in a way that payments reflect price volatility. Wages and rents are paid as percentage of rubber sales and thus relative to market prices – income risks are shared. This practice (rule-in-use) supports producers' flexibility in relation to downstream actors, because in low-price periods their production costs decrease, too). Further flexibility is offered with the option for farmers to switch to a low-input low-output regime in crop management (Bissonnette and McConninck 2017) in times of low rubber price, as mentioned above. Most equipment may be used for other income-generating activities, too, which further increases the room for manoeuvre. Middlemen, in turn, retain an opt-in-opt-out flexibility as they may rely on income from their own rubber production activities when competition among middlemen is too tight. Short-term adjustment costs for such changes are low. They also invest in maintaining a good reputation and relationships, which is in line with Gierl (2000) who argues that good relationship quality had an advantage over contractual relationships if buyers act in a highly competitive environment.

A further reaction to individually perceived uncertainty is that insecurity over future land and rubber-related regulation lets farmers not invest much in their plantations, for fear they could be taken from them again.

As regards processors, their horizontal linkages for information exchange and strategy-related discussions may be regarded as measures to attain uncertainty. Furthermore, the daily or even hourly relative price changes between factories have the likely effect that raw material is distributed in a somehow rotating fashion, and factories may rely to some degree on speedy price-responsiveness of suppliers. It remains a hypothesis whether the resulting blurred price transparency hinders a cutthroat competition.

Findings suggest that the following strategies to reduce transaction costs are used in this case, although not very frequently:

- a) Collective action: Assigning one person in the village for inquiring prices or doing negotiations; collective sales of 2-3 families together, collective transport to factory; combining rubber for sale so that factory pick-up can be ordered for all
- b) Trust related: lending money at favourable conditions to each other, due to strong and long-term personal relationships in villages; repeatedly selling to one trusted middleman. Farmers do not invest in measuring quality themselves. This means that they judge the risk of losses through fraud at the side of buyers to be lower than the cost of acquiring and maintaining the equipment for measuring rubber content themselves.
- c) Reducing control costs: making agreements and procedures in a way that fraud is not in the interest of any party (see Table 1)

- d) Biological characteristics of rubber trees: Tapping of trees can be suspended for a year without loss – the total lifetime yield of the tree is not reduced like in the case of fruit trees, for example.

It may be seen from this elaboration that the costs associated with spot markets and low-level cooperation – i.e. the “inefficiency” of this system - need to be viewed against the perceived benefits of maintaining actors’ flexibility and independence in the chain and against the background of the overall social systems of which the value chains and rural villages form integral parts.

Rational strategic choice needs to be viewed therefore in a wider perspective. Profitability of a single activity is not seen as the only guiding principle, although this is often mentioned as the most important criterion for decision-making. More implicit considerations in embedded settings have a role as well. The resulting formal and informal coordination patterns are apparently seen as effective by most of the actors involved and hence defended against suggested change. March and Simon (1958/1993) found that decision-making in organisations (of a wider sense) does not aim at finding optimum, but rather satisfying solutions. Under conditions of high uncertainty actors may strive to limit cooperation as a means to reduce complexity and ease decision-making (Simon 1976).

Conclusions and outlook

This article offers a rare insight into the functioning of rubber value chains in Southern China, including the actors involved and the business environment, relevant conditions and relationships, institutional principles and dynamics of the sector. While these could be analysed from a theoretical perspective it is impossible to say whether the functioning of this rubber system is similar to rubber sectors elsewhere, given the lack of publications on the topic. Further research could therefore explore how actors in rubber sectors elsewhere deal with specific phenomena observed in XSBN.

Our findings highlight that for small-scale farmers flexibility, including not only income diversification but also marketing choices, is a valid principle of strategic decision-making, and they are experienced in handling it. These Chinese farmers have replaced mixed subsistence farming with a single-crop income strategy by devoting almost all their land to rubber, but they have found the necessary “diversification” in the wide choice of marketing options instead, which they have learnt to master well.

Analysis shows that the institutions governing the relationships between actors in these rubber VCs do little to diminish market volatility or increase predictability of trade. Instead they are created in a way that supports flexibility of all actors to react individually to this volatility at any point in time: Institutional mechanisms support easy adaptation of production and marketing strategies at each level as well as the sharing of price changes (farmer-landlord, farmer-hired tappers), thereby keeping fixed costs at a minimum. All these mechanisms help maintaining or increasing the room for independent decision-making by actors. Benz (2004) mentions the resulting reciprocal adaptation between actors as one of the emerging patterns of interaction which form a core principle of coordination. In this way some form of stability within the prevailing instability is achieved through constant flexible adaptation.

How to maintain this equilibrium in the future is a question arising. It functions as long as factories have excess processing capacities, but this may change. Future dynamics may force actors to increase efforts towards vertical coordination for quality differentiation and traceability, increased mechanisation as well as process efficiency, due to the following trends: Quest for sustainability at the side of downstream and policy actors, saturating processing capacities (driving product quality upgrading), competition from newly developed materials, lack of labour, ageing of farmers and farm succession problems.

Future challenges include the increasing social differentiation within and among villages in NRWNR for which rubber plays a central role, as households divide into those that grow

rubber and those that cannot. It is a challenge to find alternative sources of income for rural households that do not contribute to proletarianisation of farmers, despite the prevailing land institution in China (Yan and Chen 2013).

On a more general level it would be interesting to further examine the leverage and suitable strategic responses of different actors in chains without a clear lead actor, perhaps considering embeddedness, cluster effects and different perspectives on efficiency, effectiveness and uncertainty.

Further research is required to confirm factors that make spot markets favourable for smallholders in VCs, and to make these factors available for assessment in VCD programming and by farmers themselves. The strong position of small-scale farmers in the rubber chains analysed suggests that in certain situations further integration would have no added value for farmers even in volatile markets. So far power is mainly analysed in the VCD context to identify lead actors and as well as resources and capabilities for upgrading. The possibility that farmers may be better off in a less coordinated chain is not really discussed in VCD handbooks. Ponte and Ewert (2009) find that sometimes product downgrading meant a “better deal” for DC producers as it may secure a stable and profitable supplier position when supplier competition increases. Process upgrading interventions of VCD might thus even be counter-productive. Such constellations and possibilities need attention in VCD programming. Hence authors like Figueiredo Jr et al. (2014) conclude that assessing impacts of chain interventions remains a challenge, and that viewing the value chain as a complex system where interventions in one part affect other parts of the chain, was equally important.

Further studies are needed therefore to reliably derive indicators for a viable position of farmers in a chain that leaves sufficient flexibility. Purpose should be for these findings to be usable for practitioners including smallholders, strengthening their analytical capacities for own strategic decision-making in view of future dynamics, so that they may retain and increase the range of viable livelihoods choices.

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