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Reviewing tree collaterals – a key innovation to finance smallholder forestry?

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Abstract

Smallholder forestry is continuously flagged as an integrated environmental approach and as a contribution to rural livelihoods. The individual forest smallholder does however face various constraints, especially of financial nature that limit business development or uptake of tree planting practices. Long rotation periods in forestry clash with more immediate financial needs. One potential remedy for this cash flow dilemma is the tree for loan collateral approach, where trees or the products derived from them serve as part of a security for loans. This innovative approach can ease access to financial services for land users that lack conventional collateral but requires specific lending and valuation procedures. While initial dissemination of tree collateral is ongoing, the understanding of different approaches and applications of the concept is limited. This study assesses the intricacies of tree collateral approaches through a global realist synthesis review of about 110 written sources that is complemented by eight key informant interviews. To achieve this, the study analyzes the *contexts*, *mechanisms*, and *outcomes* of the specific collateral approaches using a set of indicators. Key factors hindering up-scaling these approaches include insufficient policy for transparent valuation and registration of assets, lacking tenure, and the difficulty of exact risk calculation. Solutions to these obstacles include social aggregation of producers, improving the availability of processing sites, established markets and clear and enabling political regulations for the collateralization and registration of forest assets.

Keywords: Financial mechanisms, Innovation, Value chain, Governance, Sustainable forest management

Introduction, scope and main objectives

Achieving targets outlined in the UN Sustainable Development Goals, Paris Climate Agreement as well as global forest restoration targets set by initiatives such as the Bonn Challenge and others will rely on the involvement of smallholders (Abraham and Pingali 2020; IPBES 2018). While individual scale of forest smallholders may indeed be small, collective scale, relevance and most importantly their economic potential is significant (Verdone 2018). This also holds for the commercialization of timber from smallholder production systems. The relevance of forest smallholder's resources for their livelihoods, commercialization of timber and value chains is often overlooked (Midgley et al. 2017). Smallholder forestry can provide key contributions to rural livelihoods, or subsistence and can serve as a safety net during financial and livelihood crises (Kozak 2007; Chambers and Leach 1989).

Smallholder foresters do unfortunately face some challenges relating to their small-scale, remoteness, and unclear or overly rigid regulations (Kozak, 2007; van Noordwijk et al. 2008). The financial challenges that forest smallholders encounter lie at the heart of this study. Long gestation periods of investments into forestry and potential trade-offs and opportunity costs with crop production for more immediate returns represents a cash flow dilemma of smallholder forestry (Brancalion et al. 2012, FAO 2005).

Financial services such as loans can be one solution to bridge the gap between investment and harvest or at least some form of substantial positive cash flow. However, in many instances forest smallholders face a lack of access to appropriate and forestry specific financing (Nugroho et al., 2013). Furthermore, they often suffer from a lack of conventional collateral (Auren and Krassowska 2004) and insufficient track records with banks further complicate access to finance (Akyüz et al. 2006). The assets of smallholders are oftentimes disregarded by banks

and financing institutions (Cerdas 2005) and they are thus often regarded as “undercollateralized borrowers” (Balkenhol & Schütte 2001 p. 7).

Using trees, tree plantations or products derived from them as part of collateral arrangements for loans can serve as an alternative and innovative solution. The innate liquidity of the trees or the plantation as such serves as a security for a creditor that can be realized in the case of loan default (Starfinger 2021). To the best of our knowledge, a global synthesis of such approaches is lacking. This study, therefore, is conducted with the aim of critically analyzing a careful selection of past, existing, and planned tree collateral approaches outlined in the literature. It is based on the analytical dimensions of (i) context (ii) mechanism and (iii) outcomes. It will further discuss if tree collateral approaches in their current form are a key innovation for smallholder forestry. The phrase “tree collateral approach” is used as an umbrella term to include any transaction that *includes* forests and trees themselves but also services or products derived from them as a business security, typically for a loan. We believe that next to the scientific community, the findings will be of interest to donors, policy makers and practitioners concerned with smallholders and scaling rural micro-finance systems.

Methodology

To guide our analysis of the tree collateral approaches, we employed an analytical framework that comprises a context-mechanism-outcome (C-M-O) structure (for application of this framework see Miljand et al. 2021, McLain et al. 2018; Sarmiento Barletti et al. 2019). **Context** covers the setting or social and livelihood system as well as the regulatory environment and the land use system relevant to tree collateral approaches. **Mechanisms** comprise the actual tree collateral tool and the entities, processes, and structures they include. **Outcomes** describe any enabling conditions or inhibiting factors to the uptake and scaling or implementation of a tree collateral approach.

We choose a Realist Synthesis Review (RSR) approach, which explicitly includes grey literature in addition to academic literature. In contrast to Systematic Literature Reviews (SLRs), RSRs focus on explanatory insights and the research question rather than the quality of research (Petticrew 2006; McLain et al. 2018). These written deliberations are portrayed, analyzed, and compared in our study. An empirical review of the various tree collateral approaches available in practice, which are still undocumented would greatly exceed our scope.

Data acquisition relied on a tripartite approach: (1) scholarly databases, (2) organizational websites and (3) key informants. The following scholarly databases were used to identify academic literature: Web of Science, CAB Direct, Scopus, Google Scholar. In addition to the databases, the websites of 19 international or regional organizations were included to capture insights from grey literature. Due to the length limitations for this article, the sampling of the cases was based on the following criteria to reduce the scope: geographic distribution, conceptual diversity, and balance of promising and discontinued cases.

Results: Tree collateral approaches

Our results are presented below in sections: (i) Context; (ii) Mechanisms; and (iii) outcomes. While the context and outcome sections provide a broader overview of the situation described in the literature, the mechanism section follows a country by country and case by case structure. We cover a total of 29 cases from 19 different countries, of which 12 lie in Asia, 11 in the Americas (nine of which lie in Latin America), five in Africa and one in Europe (see Table 1).

Context

Our results show three crucial contextual elements for tree collateral approaches: social context of land users; land tenure and use rights, and regulatory and policy frameworks. First, the **social context** of the land users described in the literature reviewed are marked by mostly rural and remote settings (Xing & Ness, 2014) with limited education, financial literacy, and poverty (Salampessy et al. 2017; Zhu et al. 2020). Due to the lack of formal and conventional collateral, smallholder forestry is often perceived as a high-risk investment for banks (Salampessy et al. 2017; Kartika et al. 2019). The dilemma of limited access to appropriate financing often leads to a reliance on informal sources with at times questionable terms (Soeleman and Fitria 2020; Wandira and

Emmanuel 2021). Similarly, market outlets for the commercialization of produced timber or non-timber forest products (NTFPs) can either be limited or simply non-existent (Terán 2011). Oftentimes, the principle of social aggregation is pursued to reduce transaction costs and risks as well as to harness economies of scale (FAO n.d.; Kozak 2007).

In the context of **land tenure and use rights**, planting trees serves to “bear witness to land occupancy” (Gouyon et al. 1993 p. 193) or occupancy is even understood by locals as ownership (Peque, 2005). Similarly, plantation certificates or “land clarification letters” that document the extension, location and value of the stand and further assure use rights for a certain period are common (Mohns et al. 2011; Haryadi and Kusumowardhani 2017). State allocation of land use rights, a lease for usage rights or mid-term concessions to local communities or enterprises often occur with the aim to foster restoration and varied greatly in terms of duration (10 - 70 years) (Nugroho et al. 2013; Besacier et al. 2021; Mohns et al. 2011; Zhou et al. 2019). A clear trend in PR China is the shift away from collective land ownership to private family plots with clear use, transfer, and mortgaging rights (Liu et al. 2017; Dong et al. 2020; Dachang 2008). In most of the other countries, however, many approaches rely on some form of social aggregation of debtors (Starfinger 2021; Kartika et al. 2019). Various tree collateral approaches are also integrated into outgrower schemes (Barr and Cossalter 2004; Cairns 2000).

In terms of **livelihoods and land uses** various cases document smallholders with traditional local land use systems that are typically mixed and diverse. Their systems often also include faster growing tree species or NTFPs (Salampessy et al. 2017; Barr and Cossalter 2004; Jen 1988; Suharti 2017). The land use systems in the included literature typically had an average size of 0,3 - 18 ha and were rarely managed by industrial means. The management is typically marked by suboptimal resource use (i.e. premature harvest) due to acute financial needs and a lack of working capital for investments into improvement of stands (Soeleman and Fitria 2020; Kartika et al. 2019; Sad et al. 2015). On the commercialization side the products are often marked by a lower degree of processing or are sold as raw materials to a middleman or intermediary for a lump-sum (Casuga et al. 2008; Gouyon et al. 1993). Market outlets and processing sites are at times rare or distant and information asymmetry regarding price regimes further complicates the matter (Parthiban et al. 2011). Various cases document that trees are more of an add-on or supplement to the livelihood (Xu et al. 2020; Rohadi et al. 2012). However, there are also exceptions, where the plantations are the main livelihood (Sanudin et al. 2016).

The **regulatory and policy framework** of forestry *and* financing are key to enable tree collateral approaches. Rules, procedures, or programs for tree collateral approaches are often integrated into reforestation initiatives for smallholders (Gunter et al. 2001; Nugroho et al. 2013) or projects from development banks (Starfinger, 2021). Legislation for tree collateral approaches is mainly set at the national level for formal approaches (Sanudin et al. 2016; Ren et al. 2018; Starfinger 2021). For informal or customary approaches with a more local grounding, local traditional or the cooperative’s own rules apply (Sad et al. 2015; Adegboye 1969). Policies related to tree collateral go way beyond the forestry or land use sector and concern financial regulations, banking, ownership laws and trade laws.

Mechanisms

Table 1 provides an overview of all included mechanisms, brief outcomes, and key sources.

Asia harbors a plethora of cases and the most advanced of them in terms of scale come from *PR China* where it is called forest asset or forest rights mortgaging. Departing from comprehensive land tenure reforms and reforms in the financial and banking sector three different approaches developed: individual loans with (i) or without (ii) guarantee company as an intermediary or as a group loan (iii) to various households (Liu et al. 2017). Each of the approaches uses the forest property certificates and the use rights to said forests as collateral (Zhou et al. 2016). A key innovation of the approaches is that they are largely integrated into personal banking, rural credit systems as well as forest extension services. This integration and the use of digitalization lowers transaction costs through smart cards containing personal forest stand and credit rating information (Xing and Ness 2014).

Tree planters in Kerala, *India* can rely on a “Tree Banking” system through which they can use existing trees as a pledge to a local cooperative bank to receive loans or advances, which need to be backed by a local council of elders, called “Panchayat”. Alternatively, they can also apply for annual advance payments for newly planted saplings, which are deducted from pay out of the timber value upon commercialization (Thanal 2018).

In *Lao PDR* smallholders received plantation certificates that prove their use rights and specify stand details and value. These plantation certificates were formally accepted by a local rural savings and credit union as collateral for microloans. They further back informal barter and advance payments prior to harvest between smallholders and middlemen or saw mill owners (Mohns et al. 2011; RECOFTC 2015).

In *Thailand*, smallholders aggregated into local ‘Tree Banks’ or tree grower associations can use the current value of their trees as an add-on to conventional land collateral to obtain loans from a development bank. Some local groups developed their own approach relying solely on the tree value combined with a joint debtor scheme as collateral as opposed to land ownership (Starfinger 2021) (see figures 1 & 2).



Fig. 1 (left): A smallholder’s tree with a ‘price tag’ specifying the tree dimensions (DBH: 68 cm) and current value (1,484.80 THB (45,67 USD)), Nan province, Thailand. **Fig. 2 (right):** Smallholder in Nan province, Thailand measuring her teak (*Tectona grandis*) plantation. (Photos: M. Starfinger)

Hyman (1983) documented a loan program from the *Philippines* that allowed smallholders to include chattel mortgages on future harvests as a security for loans covering establishment costs for plantations. This was complemented by an outgrower scheme with a local pulpwood company that guaranteed minimum prices. Similarly, Lao PDR, Peque (2005) documents informal transactions between local traders and smallholders using a lien on younger stands as collateral in the Philippines.

Indonesia harbors a variety of documented tree collateral approaches. For instance, an Indonesian Government led initiative offers loans to forest smallholders to foster plantation establishment and to avoid premature harvest (Nugroho et al. 2017; Ika and Muhamad 2019; Sanudin et al. 2016). A planned but later discarded approach relied on a warehouse receipt system that documents the quantity, quality as well as the value of the stored goods like timber or cocoa. Producers can then obtain loans based on a share of the value certified on the receipt using the stored goods as collateral (Ministry of Forestry Indonesia and ITTO 2013). Many smallholders rely on at times questionable informal transactions with local traders or intermediaries, and use expected cocoa, nutmeg or rubber harvests as collateral or as tree mortgage for advance payments (Salampessy

et al. 2017; Gouyon and Levang 1993). Another approach relies on expected palm oil harvests and is offered through a cooperative (Haryadi and Kusumowardhani 2017). An interesting financing approach in conformity with principles of Islamic banking is proposed by Soeleman and Fitria (2020) called “mudharabah” that uses the trees as “biological asset[s]” (p. 62). The smallholder and an investor agree on a profit-sharing arrangement and the latter provides a loan to finance plantation establishment and management. Instead of transaction cost intensive asset valuation or interest payments, the parties simply agree to share the profits at fixed shares as a simple form of ‘repayment’.

The Americas offer a variety of different cases, which largely focus on Latin America, however. The only (documented) cases for **North America** are from the United States of America (USA). One dates to the 1960s and documents “timber loans” or “timber financing” (p. 1) issued by state, national and federal land banks, usually via local cooperatives. These loans were typically used to invest into the improvement or acquisition of stands and to avoid premature harvest. (Siegel 1967) The other more recent case documents a “zero-coupon municipal bond” (p. 6) intended as a reforestation incentive for Non-Industrial Private Forest Owners that call for the inclusion of standing trees secured through a lien as collateral for the loans *instead of* land property (Gunter et al. 2001).

In **Latin America**, there are various developed cases as well. *Costa Rica* has a public loan program for forest owners that include trees as part of collateral arrangements accompanied by a Payment for Environmental Services (PES) scheme for registered trees. These range from “micro forest credits” (translated, p. 1) to industrial scale for both individual and organized forest owners (FONAFIFO 2018). There were also instances of forward contracts being used to receive revenues prior to harvest, which can be used to finance management interventions or harvesting operations (van Dijk and Savenije 2009).

Through bundling of various loans extended to smaller scale forest enterprises, in *Guatemala* a local NGO managed to reduce transaction costs for local banks and enabled access to short term loans (about 10 months). The used the expected yield outlined in the management plans (timber & NTFPs) as collateral. This was at times complemented by a lien on future wood harvests verified through inventories (White and White 2007; FAO 2011). Another approach in Guatemala relies on incentive flows to smallholders from a PES scheme and verified management plans - both of which are used as collateral (Macqueen et al. 2018). A key strategy was applied by a blended financing approach that enabled users to provide purchase orders for wood, thus standing timber with a respective harvest permit as collateral (Besacier et al. 2021).

In *Ecuador*, an environmental mortgage scheme was proposed using the conservation status of the forest ecosystem surrounding rural land users as a security for microcredits. Depending on the conservation status the access to credit would increase or decrease (Rogers et al. 2012).

Furthermore, in *Bolivia*, Small and Medium Forest Enterprises (SMFEs) typically rely on an advance payment model called ‘habilito’ to finance management or harvest operations. They can access about 50% of the expected harvest value prior to selling both through formal contracts and informally for NTFPs like Brazil nut and rubber (Terán 2011). Another approach from Bolivia relies on “forest guarantees” for credits issued to rural forest owners or communal forest associations (FAO/Academia de Centroamérica 2016 p. 94). It used the prospective future value of the stands as collateral based on formal appraisals issued by the Government Forest Authority (FAO/Academia de Centroamérica 2016; Macqueen et al. 2018).

FAO (n.d.) documents a case in *Paraguay*, of a larger cattle and farming company relying on a trust fund which is administered by a bank and issues bonds. To secure the acquired capital of the investors, both the land and existent forest stands are used as collateral (FAO n.d.).

On the **African continent** there are generally few documented cases but some interesting recent efforts. An older case is known from Nigeria that relies on pledging of cocoa trees, for which the pledgor (debtor) uses the cocoa harvest as collateral and as interest payment, which the pledgee (creditor) harvests directly. This approach

relies on a pledge agreement drafted by a lawyer which can be complemented by a surveyor and a map of the plantation (Adegboye 1969). In *South Africa*, an example is documented for wattle tree (*Acacia mearnsii*) growers, who operate in the context of an outgrower scheme. The smallholders receive advance payments for plantation establishment or maintenance that are secured through a lien on future harvests for an involved company (Cairns 2000).

In *Uganda*, efforts by local NGOs enable smallholders to use the payment agreements of a tree-based PES scheme as collateral for loans (ECOTRUST 2020). Similarly, the F3 Life platform enables smallholders in *Kenya, Ghana and Rwanda* that manage agroforestry systems to obtain loans. A key innovation for this case is the digital compliance verification of tree-focused environmental management prescriptions that is decisive for credit scoring (Faruqi et al. 2018). Moreover, in *Uganda and South Africa*, an initiative by the New Forest Company (NFC) is lobbying with various financial institutions to eventually enable forest smallholders to use their trees as one part of collateral or chattel arrangements within outgrower schemes (Wandira and Emmanuel 2021).

Lastly, on the **European continent** there is only one documented approach, which is widely available and common. *Finland* has a well-developed system of loans issued by commercial banks that use both the forest land property as well as the value of the standing trees as collateral. This is available for both private forest owners and those that are organized in associations (Ekman 2020; Liuttula 2019).

Outcomes

Some cases suffered from a lack of long-term funding and/or commitment from NGOs or public entities or were discontinued (FAO/Academia de Centroamérica 2016). In other instances, outcomes were limited by constraints in the context that were already existent prior to the introduction of tree collateral approaches and could not be overcome (ECOTRUST 2020; Hyman 1983). Forest regulations and policies relating to tree planting, management, harvesting and commercialization of timber are described as obstacle-laden and costly in various cases (Peque 2005; Yang et al. 2020). Similarly, at times there is a lack of streamlining of relevant policies between the forest and financial authorities (World Bank 2016). Inflexible or context insensitive loan regulations represent further obstacles (Xu et al. 2020; Nugroho et al. 2013).

Explicit and quantitative information about the outcomes is oftentimes unclear or insufficiently described in the literature reviewed as can be seen in Table 1. Various cases are marked by a rather limited scale and uptake of the tree collateral approaches. It remains uncertain if some of these initiatives moved beyond pilot phases. Although the majority of the sources provide only limited information on the outcomes, it is still possible to derive key enabling conditions and inhibiting factors to adapt and or scale tree collateral approaches.

Key enabling conditions:

- clear, secure, and certified land tenure (Mohns et al. 2011; Dong et al. 2020)
- combination of tree collateral approaches with technical extension offered by governments, NGOs or involved companies on silviculture and financial mentoring (i.e. business planning) for smallholders (Ika and Muhamad 2019)
- the integration of tree collateral approaches into social aggregation (Nugroho et al. 2013) or the inclusion of local traditional authorities as guarantors (Thanal et al. 2018)
- long standing trusted relationships between creditors and debtors ideally with track records of previous loans (Haryadi and Kusumowardhani 2017)
- the bundling of individual loans into one transaction to reduce transaction costs (FAO 2011)
- comprehensive and low-cost risk mitigation procedures such as:
 - securitization through intermediary parties or bodies that provide a valuation or guarantees for repayment including collateral registries or outgrower schemes (Zhou et al. 2016; Ministry of Forestry Indonesia and ITTO 2013)

Table 1: Overview of included tree collateral mechanisms, brief characterization, key outcomes (as described in the sources) and most relevant sources

Country	Characterization of the approach(es)	Outcomes	Citation(s)
Asia			
PR China	forest asset or forest rights mortgaging, formal loans offered by banks & cooperatives to household forest owners	total loan volume by 2012 was 13,2 billion USD; described as obstacle and transaction cost laden procedure	Liu et al. 2017; Xing and Ness 2014; Zhou et al. 2019; Xu et al. 2020
India	annuity payment as advance payment for tree stand establishment or 'tree banking' on established stands of mainly fruit trees	outcome unclear	Thanal 2018
Lao PDR	tree plantation certificates accepted as collateral for microcredits	around 20 cases documented	Mohns et al. 2011; RECOFTC 2015
	barter of stands/trees amongst smallholders	outcome not specified	
	advance payments from sawmill owners or middlemen for trees or entire plantations	outcome not specified	
Thailand	loans from a development bank using the current value of registered trees as an add-on to land as collateral, issued through local 'Tree Banks'	limited roll out, widespread lack of land ownership, around 82 cases, total volume 4.4 million USD by 2020	Starfinger 2021
	'two step loan' including trees alongside a joint-debtor scheme as collateral (without land ownership)	around 6 cases	
Philippines	'chattel mortgage' on future harvest to secure loans for plantation establishment; outgrower scheme	very limited uptake; core target group barely reached, rather elite capture	Hyman 1983
Indonesia	use of the estimated tree plantation yield as collateral for publicly issued loans to delay harvest and facilitate plantation establishment	uptake is given, target groups not always reached, lengthy procedures criticized	Nugroho et al. 2017; Ika and Muhamad 2019; Sanudin et al. 2016
	warehouse receipt system - the receipt of the stored goods like timber or cocoa serves as collateral	proposed approach, never realized; propose use of existent agricultural warehouse system	Ministry of Forestry Indonesia and ITTO 2013
	advance payments for expected harvest of NTFPS from trees as well as the producing trees are used as collateral by local merchants or cooperatives	the various approaches are/were widespread but some include questionable terms for the smallholders	Salampessy et al. 2017; Gouyon and Levang 1993; Haryadi and Kusumowardhani 2017
	mudharabah profit sharing agreement (Islamic banking conform) using the expected yield as repayment for an advance payment for establishment	proposed approach, actual application unclear	Soeleman and Fitria 2020
North and South America			
United States of America	timber loans or timber financing from formal banks, usually extended through cooperatives to private forest owners	aided to avoid premature harvest; described as available in many states	Siegel 1967
	bonds based loans as incentives for reforestation after harvest; inclusion of trees as collateral proposed	planned case, outcome not specified	Gunter 2001

Costa Rica	formal loans (micro & larger) from a public entity that include tree pledging	outcome not specified	FONAFIFO 2018
	forward scheme - trade contract with advance payments of timber	brief experience, 39 cases, authors document improved revenues for forest owners	van Dijk and Savenije 2009; de Camino et al. 2000
Guatemala	Investment platform linking smallholders with clients using the wood output as collateral; packaging of various debtors into one credit using the management plans and sales contracts with a lien as collateral	unclear, project was described during the inception phase; limited loan durations, high interest rates	FAO 2011; White and White 2007
	payment flows from a tree based PES scheme from public sources is accepted as collateral	described as a longstanding program	Macqueen et al. 2018
	blended financing approach using standing timber and a harvest permit and purchase order as collateral	5 loans extended ranging from 100,000 - 500,000 USD, all repaid	Besacier et al. 2021
Ecuador	microcredit scheme that relies on the conservation or restoration status	hypothetical/planned case	Rogers et al. 2012
Bolivia	'habilito' (advance payment) used for trade of timber or NTFPs	described as a common yet default rich approach	Terán 2011
	forest guarantee - expected yield serves as collateral that is certified by government issued appraisals	various cases of extended loans, discontinued	FAO/Academia de Centroamérica 2016
Paraguay	trust fund, the company's assets including the forest serve as collateral	outcome unclear	FAO n.d.; FAO 2011
Africa			
Nigeria	pledging of cocoa trees, customary approach	current status unclear; described as very common approach at time of publication	Adegboye 1969
Uganda	Savings and Credit Cooperative offers a carbon-based approach, through which the trees or the expected carbon payments serve as collateral	some indications that previously existent social disparities limit uptake among poorer communities	Schreckenberg et al. 2013; Masiga et al. 2012; ECOTRUST 2020
Kenya, Ghana, Rwanda	ecosystem service based credit approach, focus on trees in agriculture with digital verification of compliance with environmental criteria determining credit scoring	pilot with 75 farmers described to have high compliance rates, aimed to restore 25,000 ha by 2020	Faruqi et al. 2018
South Africa	outgrower scheme with advance payments for plantation establishment secured through a lien on future harvests	low loan default rates but terms for smallholders are described as unfavourable and advance payments as insufficient	Cairns 2000
Uganda & South Africa	outgrower schemes through which smallholders use their trees as collateral or chattel	planned case	Wandira and Emmanuel 2021
Europe			
Finland	forest property (land+trees) as collateral for loans from formal banks	very common approach in Finland	Ekman 2020; Liuttula 2019

- insurance of collateralized forest assets and subsidies for insurance costs (Starfinger 2021; Liu et al. 2017)
- eased availability of data (e.g. through inventories) about the collateralized assets to reduce transaction costs and risks especially for the creditor (Starfinger 2021; Xing and Ness 2014)
- clear, transparent, and realistic valuation procedures (Ekman 2020; Liuttula 2019)

Key inhibiting factors:

- lack of clear information dissemination about the approaches (Starfinger 2021; Chaverri and Salazar 1997)
- high transaction and capital costs and lengthy application procedures (Qin et al. 2014; Dong et al. 2020)
- information asymmetry and exploitative intermediaries (Casuga et al. 2008; Salampeyy et al. 2017)
- underdeveloped value chains: few or no market outlets and limited processing infrastructure (Parthiban 2011)
- rigid, prescriptive or context insensitive loan attributes or forest and finance regulations (Nugroho et al. 2017; White and White 2007)
- obligation to include land property as collateral (Starfinger 2021; Gunter et al. 2001)
- lack of local branches of banks or associations (Soedomo 2014) or hesitance amongst these (Nugroho et al. 2013)

Discussion

Our results show that Asia harbors most of the documented cases, followed by the Americas, which is dominated by cases from Latin America. Africa and Europe seem to be lagging behind, but it is possible that there are undocumented cases or cases that despite careful testing were not captured by our search strategy.

Key approaches that we identified rely on plantation certificates, inventories, management plans, cooperatives and other intermediaries, PES schemes, outgrower schemes, forward and future schemes, bonds, pledges etc. for securitization and facilitation. The provided overview and insights from our analysis of the various approaches provide a solid base for the adaptation and development of further tree collateral approaches in support of smallholder forestry. However, it is likely that either public or NGO support will be required to scale and establish tree collateral approaches as hesitance amongst financing institutions persists. However, the variety of approaches that we compiled and analyzed, and their diverse risk mitigation approaches provide a solid basis for continued efforts. While the Chinese case underlines the need for a clear guiding policy and shows an impressive scale, other cases show us how organic development of local approaches (e.g., Thailand, Lao PDR, Bolivia) can at times lead to more locally adequate mechanisms.

On the one hand, tree collateral approaches hold potential to be a key innovation for forest smallholders as they can provide opportunities. This holds for the inception stage to foster investments into stand establishment, management interventions, and can bridge cash flow constraints during the long gestation period as well as to finance at times costly harvesting and commercialization operations.

The potential to be a key innovation is limited as essential questions and prerequisites for successful implementation and scaling of tree collateral approaches are still unanswered. These include differing or nontransparent valuation approaches by intermediaries or middlemen, lacking access to markets and hence limited liquidity of the collateral, tenure issues and accessibility. The tenure issue is emblematic of how tree collateral approaches rely on a solid existent forest governance as a prerequisite, which is not always a given.

Conclusions & recommendations

This study has reviewed scientific and grey literature to extract observations that report various tree collateral approaches in different geographical regions. Based on the analysis, we can conclude that tree collateral holds great potential for smallholders with limited access to finance as it can foster investments into stand establishment and maintenance if some of the remaining key challenges are addressed and an enabling forest

governance is given. Despite the limited scale of various approaches, easing access to finance through already existent assets that smallholders manage bears a great potential.

While this study could contribute to the existing literature on forest finance and smallholders, many questions remain unanswered and various avenues for further investigation exist. For instance, more research would be needed focusing on empirical inquiries into the described and potential other tree collateral approaches. These inquiries could focus on the conceptual intricacies of the tree collateral mechanisms and could provide updated and critical reflections on outcomes. Similarly, such assessments could critically reflect on the financial viability and scalability of the mechanisms. Both of which are aspects, which were rarely addressed in the assessed literature.

Furthermore, our analysis allows for some recommendations for practitioners and other stakeholders. These could focus on implementing pilots with tree collateral approaches ideally building on scaling locally grounded approaches. Within this context it is essential to document initiatives and to explicitly include insights into scale, success factors, and shortcomings to allow for critically constructive reflections.

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