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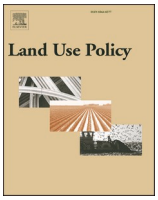

Beyond the 'Field of Dreams' model in smallholder forestry: Building viable timber value chains for smallholder tree growers in developing countries

Dora Carias [a,*], Tony Page [a], Hilary Smith [b], Digby Race [c,a,b], Rodney J. Keenan [d], Graeme Palmer [e], Jack Baynes [a]

[a] Tropical Forests and People Research Centre, Forest Research Institute, University of the Sunshine Coast, Maroochydore 4558, Australia
[b] Fenner School of Environment and Society, Australian National University, Canberra 2601, Australia
[c] Land Management & Development, University of the South Pacific, Suva, Fiji
[d] School of Ecosystem and Forest Sciences, University of Melbourne, Melbourne 3010, Australia
[e] Faculty of Environmental Science and Engineering, Southern Cross University, Lismore 2480, Australia

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ABSTRACT

Many smallholder tree growers in developing countries and those advising them, hold a view that if they plant trees a market will materialize when the time is right. However, despite strong international demand for timber and potential for smallholders to supply this demand, this 'Field of Dreams' approach, i.e. if you grow it, buyers will come, is not generally a sound strategy. In this study, we aimed to identify the conditions that enable the development of viable timber value chains around smallholder tree growers in developing countries. We reviewed literature on the integration of small-scale producers into value chains, smallholder tree growing, and smallholder commercial forestry to identify conditions, and used four case studies in the Asia-Pacific Region to understand how these influence outcomes for smallholder tree growers in different settings. This analysis provided a basis for recommendations for policymakers and advising agencies on how to support timber value chains for smallholder tree growers. These included deeper understanding of biophysical suitability of locations for tree growing, smallholder capabilities and interests, and provision of clear land tenure, infrastructure, and streamlined regulations sympathetic to smallscale timber operations. Tree growing can generate financial value for smallholders in regions with high human population density, quality road networks and proximity to processing markets and ports. Careful policy design is required to make it 'fit for purpose' at local levels, as conditions vary widely even within a single country. This can identify catalytic interventions and work with existing or near-term market drivers and simplified regulations in the value chain to generate benefits for smallholders.

1. Introduction

A growing and wealthier global population is fuelling international demand for timber and wood products (McEwan et al., 2020; Versteeg et al., 2017; Barua et al., 2014; Aoudji et al., 2012). Timber supply from natural forests is declining and the potential to expand supply from large-scale industrial plantations will mainly come through increased productivity, with an expansion in area constrained by environmental, social and food security factors (McEwan et al., 2020). Smallholder family farms and community forests are potential sources of new timber supply. Their contributions as tree growers to commercial wood supplies may become critical (Arvola et al., 2020; Nambiar, 2021; Midgley et al., 2017).

Smallholdings are small areas of land in the rural tropics used for subsistence or commercial purposes, relying mainly on family labour and management, and with family ownership of limited assets (Byerlee, 2014; Pokorny et al., 2010). Although it is not a new phenomenon, the scale of smallholder tree growing is becoming more significant (Arvola et al., 2019). In many parts of the world, these smallholder plantations support small and large industries such as furniture, construction, veneer, medium-density fireboard, export woodchips, pellets, and pulp and paper industries among others (Arvola et al., 2019; Nambiar, 2019; Midgley et al., 2017). These commercial linkages also provide a series of economic and non-economic benefits for rural households and communities such as increased incomes, higher crop yields, land use rights, and ecological services (Nigussie et al., 2021; Schirmer et al., 2015;

* Correspondence author.
E-mail address: dcariasvega@usc.edu.au (D. Carias).

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Pokorny et al., 2010).

Although smallholders successfully produce commercial timber in some countries, in others development of this sector is limited (Do and Mulia, 2018; Schirmer et al., 2015; Harrison et al., 2008; Roshetko et al., 2008). In terms of research, attention has been paid to the factors that constrain smallholder tree growing, including lack of secure land tenure, weak market demand and low prices for smallholder timber, limited tree growing knowledge, lack of viable production technologies and inputs, and high production risks for smallholders (Arvola et al., 2020; Byron, 2001; Godoy, 1992). However, information about the needs of the other parties involved in transforming timber from its raw material stage to the final consumer is much more limited in comparison. This is problematic because smallholders do not produce in isolation. Motivation to produce in the long term can only be achieved by understanding the needs and roles of actors in the demand or 'pull' side of the equation (Midgley et al., 2017; Poulton et al., 2010). In the movie 'Field of Dreams' the lead Ray Kinsella constructs a baseball field on his farm in US Midwest in the belief that if he built it, 'the players would come'. Many smallholder tree growers in developing countries, and those advising them, also adhere to the belief that a market will emerge for the wood they grow. However, despite strong international demand, and the potential for smallholders to supply this demand, markets have not materialized. This has left many growers disappointed.

This article addresses this knowledge gap by identifying the conditions that enable the development of viable timber value chains around smallholder tree growers. The value chain perspective allows the exploration of the range of activities implemented by various actors in the chain, from raw material production and transport to the retailing of the final product (Midgley et al., 2017). Unlike supply chain thinking, value chain approaches integrate characteristics of both supply and demand, providing a systemic view of the chain (Collins et al., 2015). We used case studies from four developing countries in the Asia Pacific region to illustrate the effects and interactions of these conditions in different settings. We also provide recommendations for building viable smallholder timber value chains in developing countries. The study looks exclusively at timber production for commercial purposes, not firewood or non-timber forest products, because timber production and sales are likely to generate the largest potential rents for smallholders (Wunder, 2001).

The main objectives of this study are:

a) To identify a comprehensive set of conditions that enable the entire range of actors to engage in viable smallholder timber value chains;
b) To understand how these conditions influence outcomes and interact with each other in different settings;
c) To provide recommendations for policymakers, government officials, and advising agencies on how to support development of viable value chains around smallholder tree growers.

The paper is organized into five sections: Section 2 describes our methods including the case studies; Section 3 provides a detailed description of our results, while Section 4 develops a discussion on our key findings and some recommendations; Section 5 provides some general conclusions.

2. Materials and methods

2.1. Literature review

A purposive literature review provided a broad indication of enabling conditions for smallholder tree planting and integration of small rural producers into value chains. Purposive sampling of the literature is known to be selective and subjective, and adequate when researchers are clear on the purpose of their studies (Black, 2010). As Hajjar, et al. (2017), who analyse enabling environments for forest enterprises, we compiled various relevant perspectives to provide a broad view of essential elements and did not rely solely on one theory or explanation. We selected information-rich articles that gave insight about the phenomena of interest (see Creswell, 2009). The search was limited to low- and middle-income countries. Searches were conducted through the online database Google Scholar supplemented with results from Web of Science, using combinations of terms associated with four concepts of interest: a) smallholders, b) enabling conditions, c) timber, d) value chains. Table 1 summarizes the main terms or concepts used in the search and how they were expanded to attempt to cover relevant articles.

The titles and abstracts of the articles were used as an initial indicator of potential usefulness for the study. Further detailed reading of the documents then provided the final decision to select or discard the documents. The selected documents were published or *in press* in peer-reviewed academic journals focused on forestry, agroforestry, land use, development, and rural livelihoods. Reports from non-governmental and aid organizations involved in integrating developing country small-scale producers in value chains were also used. The documents were published in English between January 1990 and June 2021. A new search was conducted in September 2021 to cover newly published literature. Twenty-nine relevant documents were selected for further investigation. Another twenty-seven articles were selected from the reference list of the first batch of articles.

Guided by previous investigations on enabling conditions for environmental policies and natural resource approaches (see Huber-Stearns et al., 2017. and Katila et al., 2014) and by expertise on community forestry, the publications were analysed and content coded in NVIVO according to broad sociological themes including biophysical, economic and financial, social and human capital, and institutional conditions. More themes were identified through the coding process and were then used to develop six categories of enabling conditions.

2.2. Case studies

To investigate these factors further, we used case studies. According to Tight (2017) the term 'case study' is, or should be, reserved for a particular design of research, where the focus is on an in-depth study of one or a limited number of cases. The basic analytical strategy offered for case study research is to compare what is observed in the case or cases with what was expected (for theoretical or logical reasons), hypothesised or observed elsewhere (see Yin, 2009). We adopted an instrumental case study approach (Hyett et al., 2014) to advance theory and understanding of the object of interest, in this case the existing conditions of four timber value chains involving smallholder tree growers in different countries. We compared these to broad factors expected to enable viable value chains identified in the literature review.

To standardise the cases and maintain uniformity, a case study guide was developed framed around the enabling conditions identified in the literature review (see Appendix). The structure of the analysis was to describe the context, nature of the tree growers and other value chain stakeholders, impediments, and enablers of value chain development, and make an overall assessment of presence or absence of enabling

Table 1
Main and expanded terms used in literature search.

#	Main terms	Expanded terms
1	Smallholders	Smallholder* OR Farmer* OR 'smallholder producer* ' OR 'small-scale producer* '
2	Enabling conditions	'Enabling condition* ' OR 'enabling factor* ' OR 'prerequisite condition* ' OR 'success factor* '
3	Timber	Timber OR tree* OR woodlot* OR plant* OR forest*
4	Value chain Region: developing countries	'value chain' OR market* OR commercial*[a]

[a] The term commercial* was used to capture literature focusing on smallholder forestry as a commercial venture, not solely subsistence.

conditions and possible areas of intervention to improve on present outcomes. The case studies were written using existing literature, personal visits, and observations. The case studies cover teak (*Tectona grandis*) in Luang Prabang province, Northern Laos; whitewood (*Endospermum medullosum*) in Espiritu Santo Island, Vanuatu; acacias (*A. auriculiformis*, *A. mangium*, *A. mangium* ×*auriculiformis* hybrids, and *A. crassicarpa*) in Thua-Thien-Hue and Quang Tri provinces,[1] Vietnam; and sengon (*Paraserianthes falcataria*) in Pati, Central Java, Indonesia. The case study sites were chosen because the authors had strong expertise in value chains in these locations. The Asia-Pacific region is also an area where various governments have incentivized smallholder tree growing for various purposes including timber supply for industry.

The authors evaluated the presence of the enabling conditions in the value chain in each of their case studies. The colour green was used to indicate that a condition was present, red if it was not present, and yellow if it was partially present. The importance of the condition in creating the outcomes documented by the case studies was also rated using a qualitative scale: from 1 (insignificant) to 5 (very important). This was followed by an in-depth assessment of each setting and factors that varied between case studies. The aim was to find points of similarity and difference among the cases.

There are limitations to this approach: first, although the authors have deep experience in each of the case studies, none had experience across all the cases; second, they each have individual fields of expertise which might bias or influence their responses and recommendations because they know more about some enabling condition than others. Nonetheless, expert knowledge is still a valid method because it is characterised by a high degree of reflexivity, of coherence or certainty (Bogner et al., 2018) and is useful in the processes of distilling key issues for making recommendations to improve value chains or for policies. Moreover, value-chain research is multi-disciplinary, and the strengths of the expert specializations potentially enhance the depth of interventions proposed (Collins et al., 2015).

2.2.1. Teak (Tectona grandis) in Luang Prabang province, Northern Laos

2.2.1.1. Context. Lao People's Democratic Republic (Lao PDR) is a small, lower-middle-income country, geographically enclosed in South-East Asia. Lao PDR's economic development has been heavily reliant on its natural resource endowments, and forestry and wood processing have been key contributors (World Bank, 2019). Laos started "opening up" in the late 1980 s (Yamada, 2018). The value of natural resources and the extent to which forests were being diminished by unsustainable and unregulated harvesting, soon became apparent. For farmers in Northern Laos policies on markets, domestic processing, land, forests, shifting cultivation, poverty reduction and socio-economic development converged, and catalysed access to land for tree plantations. Enabled by a Land Forest Allocation Program (LFAP) in the 1990 s, policies to encourage planting teak (*Tectona grandis*) in Northern Laos (see Fig. 1) were effective, and today thousands of households grow teak as part of diversified livelihood strategies.

Teak is native to Laos and was cultivated during the period of French occupation, but it was the LFAP that accelerated its widespread adoption. The program and the legislation that served as its foundation, provided farmers with a mechanism to gain access to the newly available land use rights, permitting each labour unit (capable adult) within a family to plant trees on up to 3 ha of degraded land, supported by government extension and free seeds; many farmers strategically 'booked land' by planting Teak (Smith et al., 2017; Newby et al., 2014). The Government reports around 50,000 ha nation-wide of land under Teak production (Department of Forestry, 2020), but other sources suggest the area may be less (Boer, 2019).

Private ownership of plantations in Laos is principally established through the act of tree planting, but formal plantation registration has been a legal requirement since 1989. Less than an estimated 10% have completed this procedure (Smith et al., 2017). Although the rules for plantation registration are relatively straightforward and the process incentivised through land tax exemptions, the cost of the highly technical procedure is prohibitive to growers who sell only a few trees each time, and it is difficult for local officials to implement. Together with regulations for other steps along the value chain including harvesting, transporting, sale and export of plantation timber, this complex regulatory environment is pushing teak smallholders into informal markets, or out of market participation completely (Smith et al., 2017).

2.2.1.2. Smallholder tree growers. Most teak plots have been planted by rural households in small parcels of around 1 hectare, integrated with other subsistence and commercial land use activities, and largely concentrated around accessible roads and rivers (Mienmany, 2021; Boer, 2019; Newby et al., 2014). Adequate inputs for teak production are locally available; planting material is accessible although the most affordable is of mixed quality, and labour is generally household or extended family. Land is now the most difficult input to access, and those choosing to plant teak are doing so in more remote, inaccessible, and less suitable areas (Boer, 2019). Plantation management is minimal (Pachas et al., 2019) as growers see teak as a long-term, low-labour, low-input asset and together with poor site selection, has resulted in stands being of mixed quality and trees small for their age (Boer, 2019). Smallholders sell trees for income on an as-needed basis selecting the highest value trees each time as needed (Smith et al., 2017).

Trees are sold 'standing' or as logs in the forest to traders buying small volumes for local, low standard sawmills or to brokers for larger, typically foreign processors. Smallholders prefer to sell at a lower price to buyers who will pay immediately on site, and who will pay for administrative responsibilities and costs (Smith et al., 2017). They sell locally to people they know and trust, and in some areas selling occurs within ethnic groups. There are barriers to markets for thinnings, with regulations prohibiting the sale of small diameter wood. These products are used for domestic purposes - housing, fences, fuel, and charcoal.

There are teak grower groups and enterprises that undertake administrative tasks, participate in training and dissemination, sell the wood of group members, and/or process the wood of members. However, groups have not been very effective because they have been unable to consolidate consignments big enough to attract large processors (Ling et al., 2018). Groups are difficult to formalise in Laos due to regulatory-cost barriers and inequality in between members is eroding trust, connectedness, goodwill, and common livelihoods (Ling et al., 2018; Smith et al., 2017).

2.2.1.3. Traders, processors, and exporters. Policies require that products must be finished before export, so smallholders are highly reliant on localised primary processing. Traders are essential in connecting tree growers to markets by buying, harvesting, and transporting the geographically dispersed wood. Harvesting and haulage uses low-technology inputs, principally chainsaws for cutting into 2 m billets, and manual haulage to road- or river-side for transport to primary processors. Simple technology makes extraction possible but labour intensive. Independent traders or company-brokers often buy standing trees and organise harvesting because of chainsaw ownership rules. Buying teak from smallholders is low risk but unpredictable with teak being a long rotation crop and growers harvesting and/ or selling only when they need money. Supply contracts are rare. Processors buy via traders who source and deliver wood, or they source it directly from growers in their geographic area. Although traders and brokers are the main aggregators and essential service providers, they are viewed negatively by some sectors of government and others in the supply chain (see Mienmany 2021).

[1] We will also refer to these provinces as 'North Central Vietnam'.

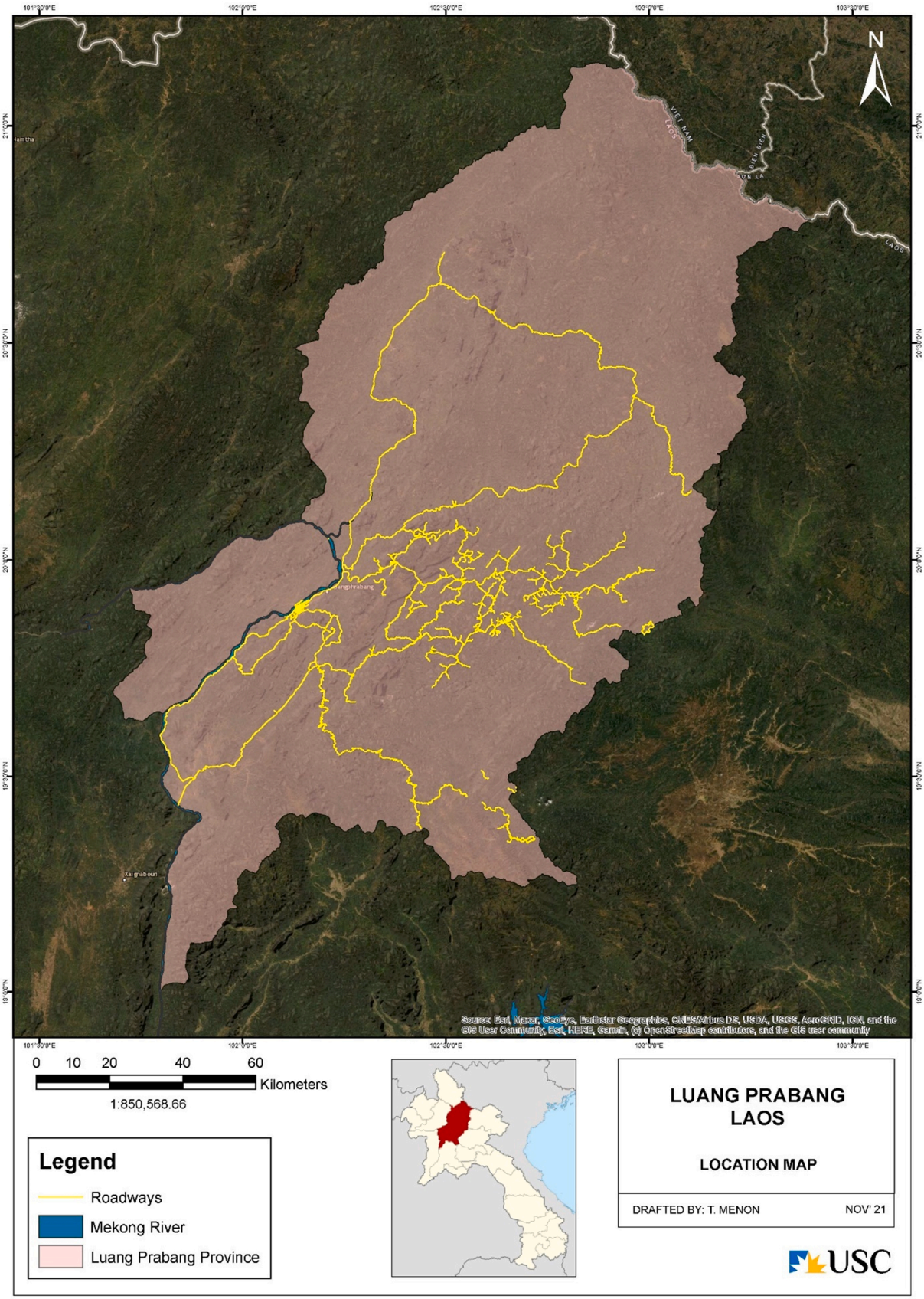

Fig. 1. Location map of Luang Prabang, Laos PDR.

2.2.1.4. Impediments to value chain development. Tree planting policies in Laos have been undeniably successful in reaching planting targets, but their performance against government objectives for wood supply for industry and income generation for farmers are questionable. Policies encouraged farmers to plant trees, but they were viewed as a way of securing land use rights and gaining the financial security that comes with this, with many farmers simply 'following others' (Mienmany, 2021). Rather than selecting land based on tree-growing suitability, many trees were planted in areas with unsuitable biophysical characteristics and in small, geographically dispersed plots. Growers are now apprehensive about clear felling because they fear losing their land use rights if all trees are cleared. These factors, along with overly dense stocking and lack of silviculture and management has created sub-optimal stands both in terms of quantity, quality, and reliability for processors (Pachas et al., 2019; Maraseni et al., 2018; ACIAR, 2017). This has limited economies of scale, and thus the capacity to invest in higher value processing options. Low quality wood has kept low the price the processing industry is willing to pay, disappointing growers who have waited decades to harvest.

In June 2016, the government banned the export of unfinished wood products through Prime Ministers Order No 15/NA on Strengthening Strictness of Timber Harvest Management and Inspection, Timber Transport and Business on 2016 'PMO15'. Introduced primarily to curtail the trade of illegal timber from natural forests, wood from teak plantations was also captured in the ban, with teak still growing naturally in Laos within a very small remnant range, and no sure way to differentiate between sources. The most immediate effect of PMO15 was that the borders closed to teak logs, leaving growers no choice but the sell their wood domestically. However, with the forced closure of over 1100 micro and small wood processing enterprises in response to PMO15, their options were limited. The specific product dimensions set in new export rule (initially negotiated by large, well connected wood processors) further limited markets for small and lower quality logs. The low returns from plantations that have taken decades to grow means that farmers' motivation to manage and maintain their teak plantations is reduced further, and the compulsion to comply with regulations such as plantation registration, which is only really enforced at the time of harvest, is diminished.

2.2.2. Whitewood (Endospermum medulosum) in Espiritu Santo Island, Vanuatu

2.2.2.1. Context. Vanuatu is a Pacific Small Island Developing State (PSIDS) (Manoa, 2015) with a population of over 250,000. While historically forestry has been a significant contributor to Vanuatu's export earnings, as national timber volumes have decreased over the past ten years so too have royalties available to the Vanuatu Government. This decline in timber resources has led to an increasing reliance on imports of wood for local construction. In 2013, the Vanuatu Government set an annual sustainable yield for logging from native forests and forest patches in agricultural zones at 68,000 m^3 (VDoF, 2013). However, natural timber supply remains constrained by the exhaustion of natural stands during the 1980 s and 1990 s, with current sawn timber production of ~10–15,000 m^3 annually.

Vanuatu has sought to rebuild its resources through smallholder woodlot establishment. Whitewood (*Endopsermum medulosum*) is native to Vanuatu and has been designated as a priority species for plantation development by the Vanuatu Government for timber production. The Vanuatu government, through the Vanuatu Forest Policy, set a goal of establishing 20,000 ha of forest plantations by 2023. The species is well adapted to plantations with its rapid growth, good form, pest and disease resistance, tolerance of high wind, and production of fine grain white timber. Strategies for conservation and tree improvement date back more than twenty years (see Corrigan, et al., 2000) and domestication is also well advanced, yet development of a plantation estate has been slow.

Economic growth and development in the country's two urban centres (Port Vila and Luganville) have driven demand for preservative-treated timber used in light and medium construction, furniture and cabinet making, veneer and plywood, interior trim, joinery, carving and turnery, and panelling. Although whitewood is readily accepted by wood manufacturing industries in both domestic and export markets (Viranamangga et al., 2012), much of this demand for construction timber is currently satisfied with imported pine from New Zealand as native forest timber volumes have continued to decline. A large percentage of the imported softwood timber is not structurally graded and so there is potential for local timbers to compete on this basis. Estimates show that on Espiritu Santo, the sustainable volume of sawn wood is approximately 1200 cubic meters per annum which could be readily consumed in the domestic market.

Although whitewood is a species of primary interest, it presents some limitations. It has low density and therefore strength, low durability to biodegradation and is particularly susceptible to discolouration by blue staining fungi immediately after sawing. These limitations can be addressed through technical means. Low strength properties can be overcome by larger dimension pieces for equivalent strength grades for pine. Blue staining fungi can be prevented by drying the timber, either in the sun/air or ideally in a kiln. Durability properties of whitewood can be improved through preservation treatment with chemicals using vacuum and pressure processes. However, this treatment is expensive and only three operators in Vanuatu offer it. Limitations of whitewood performance relate to existing production and processing capacity when compared with imported timbers. These include lower consistency and accuracy of timber dimensions; lower conformance to treatment standards; and a more limited and less consistent supply.

Prices for whitewood timber vary depending on location and level of processing. Planted forests receive about the same prices as native forests although planting costs more, so it is hard to make money on plantations unless higher uniformity, quality, and stocking rates per hectare offset the initial costs. The retail price for air-dried and treated whitewood is comparable to that of imported radiata pine. Markets for lower value products based on thinnings and knotty wood are undeveloped, leading to low wood utilization.

2.2.2.2. Smallholder tree growers. Whitewood has been planted by landholders on many islands in Vanuatu, with the greatest area of planting occurring on Espiritu Santo (see Fig. 2).

Smallholder whitewood plots are mostly under customary ownership and on average about 0.68 ha. Capital investments such as ripping and fertilizing are unnecessary because the land is of sufficient quality. The Vanuatu Department of Forestry staff conducted a review of existing seedling distribution data and surveyed 40 plantations at the end of 2018, located along the east and south coast of Santo. The survey results are summarised as follows:

- An estimated volume of 10,600 cubic meters of merchantable whitewood is ready for harvest during the next two years. This excludes a majority planting owned by Melcoffee sawmill that is unavailable to new processing operations.
- This volume exists on over 500 sites in the study region.
- Many of these plots present difficulty of access; they are often located up to 70 m from the closest road which are commonly in very poor conditions.

In general, the plantings are small, dispersed, located away from roads and under varied management conditions. No pruning or thinning has taken place in many stands. The concept of non-commercial

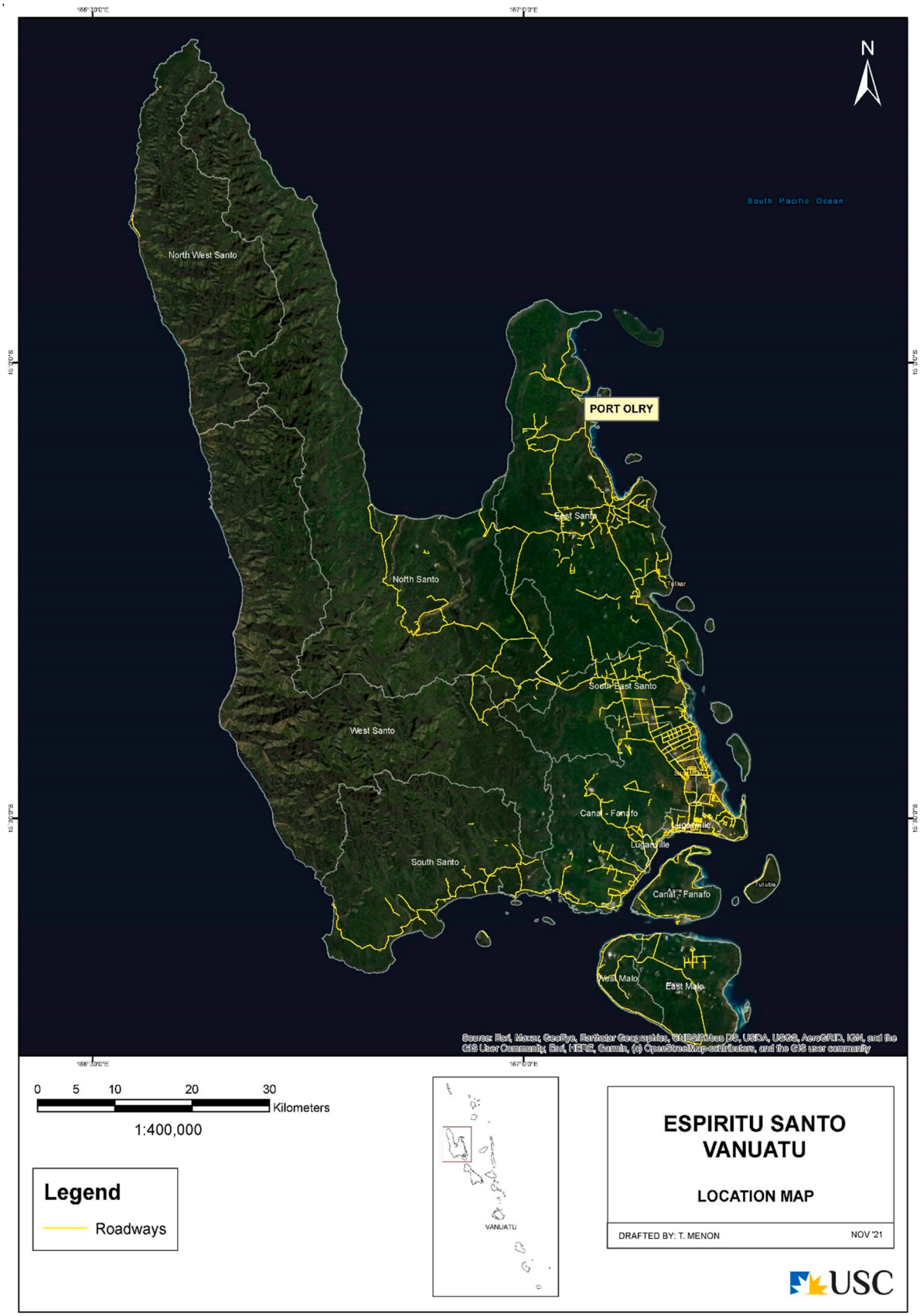

Fig. 2. Location map of Espiritu Santo, Vanuatu.

thinning[2] is not accepted by farmers.

2.2.2.3. Mobile sawmill operators, timber yards and secondary processors. Smallholders mostly sell wild trees mixed with planted ones to Lucas portable sawmill operators. Operators produce green rough-sawn timber which is transported via road and boat to timber yards and secondary processors. Supplies on Efate or Santo will go to Vila or Lugganville respectively. Transportation of the timber is a major challenge because roads are in poor condition and can be impassable during the wet season. Some timber yards send their own sawmill operators to harvest smallholder trees if there is high demand. Portable sawmills have the advantage that primary processing can be done on-site in areas with poor infrastructure. They are also economically and technically accessible for small-scale processors. However, sawing small diameter trees with circular-saw portable-mill technology is difficult leading to low woodlot utilisation, low timber recovery and high levels of waste. Rough-sawn boards are highly susceptible to blue staining fungi, so processing is usually done during the dry weather season or sunny days to air dry the boards and reduce blue stain.

Once in the hands of timber yards and secondary processors, the timber undergoes additional processing including preservative treatment, kiln drying or air seasoning, docking, and dressing before sale to consumers. Secondary value-adding processors process rough sawn boards into furniture and mouldings. Many of these secondary processors own building companies which are the main market for mouldings and furniture.

Impediments to value chain development.

There are few biophysical impediments to the establishment of a successful whitewood estate. However, the transition from wild to planted resource presents considerable challenges to both growers and processors. The current value chain was developed on the conditions of tree size and access for natural forest wood, and the regulations that governed its use. The historic price of wild whitewood trees is still used as a reference for establishing planted log prices, despite the additional costs of planting and management relative to wild stands. Low prices are also influenced by low utilization of planted trees due to market preferences for first grade clear timber, and the technical challenges of sawing small and knotty logs. The profits differ along the value chain with those with the most knowledge or business power (traders and mills) making the most money while small and dispersed growers make less. Profit taking at critical steps of the value chain such as timber treatment leads to collapse of the chain of production and processing.

For primary and secondary processors, several factors impede flows of viable quantities of logs. Government pursuit of macro scale policies by supporting programs to broadly encourage planting has led to a geographically dispersed whitewood resource. Whitewood stands are found in small, dispersed plots located away from transport infrastructure. The harvestable volumes are low and of variable quality. Portable sawmills must be moved by sea and/or land across multiple operation sites, which inflates transport costs, as do fuel and labour costs. Transporting the timber to markets before blue stain fungus develops is another challenge faced by sawmillers. These factors make the resource expensive to harvest. Moreover, processors need quality logs that can only be produced when farmers are committed to good plantation management. Given a supply of adequate timber, whitewood processors will have to match the consistent specifications of dimension and durability of imported timbers.

2.2.3. Acacias in north central Vietnam

2.2.3.1. Context. The 1986 'Doi Moi' economic reforms in Vietnam were aimed at structural adjustment to a free-market economy, opening up to trade and generating rural income to reduce poverty (Raymond, 2008; Ohlsson et al., 2005; Pingali and Xuan, 1992). 'Market socialism' allowed farmers to lease land and to sell crops privately and forest land was allocated to households or individuals for long term use. Households could exchange, transfer, inherit, lease and mortgage land-use rights (Dang et al., 2012)(Do and Le, 2003). Since these reforms, the forest sector has transitioned from strong state control to increasing dominance of large- and small-scale private actors. Reforestation programs from the government of Vietnam have increased forest plantation area to 4.32 million hectares and fulfilled the timber demands of industries while increasing income to rural populations. The reforms and other incentives spurred the development of commercial plantation forestry and manufacturing of wood products, making Vietnam the world's largest exporter of hardwood chips (Nambiar, 2021) and fourth largest furniture exporter (Tham et al., 2020).

Currently, three hundred thousand small growers individually manage 1–5 hectare holdings, contributing to 50–60% of domestic wood supply from various sources (Huong et al., 2014). Wood is an attractive product for households because it requires relatively little cash outlay and family labour can be used to prepare the site and grow trees. Australian Acacia species (*A. auriculiformis, A. mangium, A. mangium* ×*auriculiformis* hybrids, and *A. crassicarpa*) are the mainstay of commercial forestry (Nambiar, 2021), selected for wood properties, ease of establishment and growth rates on degraded sites.

2.2.3.2. Smallholder tree growers. The north-central coastal region of Vietnam has been a centre for rapid plantation establishment and now has some of largest areas of planted forests in Vietnam. Total plantation area in the two provinces of Thua Thien-Hue and Quang Tri is 183,000 ha (see Fig. 3).

About 80% of this area is Acacia species (Rizetti et al., 2018). Approximately 40% of plantations is owned and managed by households, with the remainder owned by state forest companies or businesses. The exact number of households involved is not clear, possibly 20,000 households are involved. Average land ownership of households is 3–5 ha, but ownership is unevenly distributed with 5% of households owning 10% of the area in larger holdings and 85% owning less than 3 ha. Plantations tend to be clustered in foothill areas adjacent to rice paddy and agricultural areas, within 40 km of population centres, processing plants and export ports and generally have good access to infrastructure (Rizetti et al., 2018). Land allocated more recently tends to be further from roads and markets.

Household growers typically plant trees at high stocking (2500–3000 stems per hectare) and harvest at 4–6 years. Some growers with larger holdings are growing trees with lower stocking to a larger size over 6–10-year rotations. The large number of households involved imposes significant transaction costs on those involved in supply chains. The market relies heavily on traders as intermediaries and these provide important services such as organising harvest, transport, and markets (Maraseni et al., 2017). Many traders are operating in the market, and they rely on social connections to develop relationships with household growers within a commune or locality. Most of the harvesting and transport to the road is done by hand. Traders employ local people for harvesting and transport. Debarking is done by local people who use the bark as a fuel source.

The demand for pulpwood, non-certified logs for export of hardwood woodchips, has provided smallholder farmers with quick returns for their forestry land (Blackburn et al., 2020). However, the furniture industry has been rapidly expanding and a lack of locally produced, non-certified and certified sawlogs has forced the industry to import up to 80% of the timber required for production (Blackburn et al., 2020). Growers have invested in short-rotation acacia plantations primarily for the woodchip market but are being urged through government policies and pressured by NGOs to shift to longer rotations for growing sawlogs

[2] The effects of thinning on stand productivity are still being studied and results have been contradictory (see Pretzch 2000 and Weigel, et al. 2018)

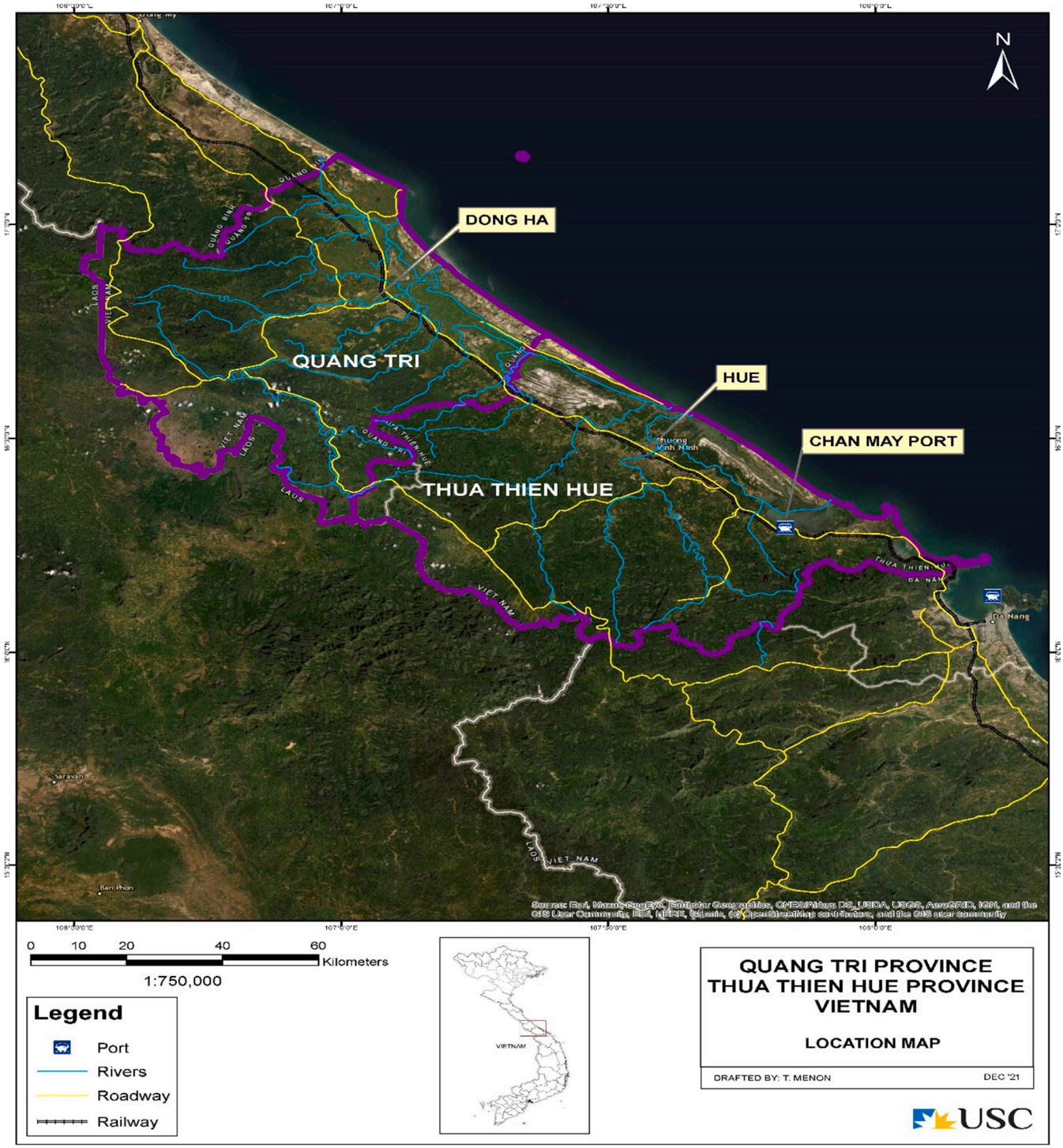

Fig. 3. Location of Quang Tri and Thua Thien Hue Provinces in Vietnam.

for furniture (Nambiar, 2021) (Huong et al., 2014). Growers usually sell when the trees reach a minimum harvestable size.

Producing woodchips requires relatively simple cultivation techniques and is financially very profitable for smallholder growers (Frey et al., 2018), particularly if they have need for short-term income and inherently apply a high discount rate to future income. Shorter rotation periods permit intercropping which fits well within growers' livelihood strategies and is a form of risk management. The price difference between woodchip logs and sawlogs is relatively low (typically US $45-$50/t for chip logs and US$60-$65/t for small sawlogs and for small sawlogs).[3] Households therefore have little incentive to grow trees to a larger size. Potential risk of losses due to typhoons or disease is another major barrier for growers to produce larger logs in longer rotations. Households generally sell their trees in a lot to traders for a given price and have limited understanding of timber price per unit volume or mass or the prices for different sized logs.

[3] VND 0.9 – 1.0 M/t for chip logs and VND 1.2–1.3 M for small sawlogs

2.2.3.3. Log traders, processors, and exporters. Log traders generally manage harvesting, log sorting for different markets, and transport and incorporate these costs in returns to growers. Traders are often only equipped to handle smaller logs and the margin for traders is similar for small or larger logs, so they are not incentivised to promote larger log production to growers. Traders do not provide finance to growers.

2.2.3.4. Impediments to value chain development. The Government of Vietnam is investigating policies to support smallholders producing larger logs and generating greater social, and environmental benefits (Blackburn et al., 2020). However, the uptake of sawlog production for non-certified and certified furniture production has been slow. For one thing, the price differential between timber for woodchips and for sawlogs is currently not enough to act as an incentive for smallholders or for traders. The price of larger logs can potentially provide higher returns and incentives than growing chip logs, but other factors must be taken into consideration.

Small diameter log production for woodchips is profitable for farmers and fits well within their livelihood strategies. Smallholder tree growers want short-term, low risk income (Nambiar, 2021; Zhunusova et al., 2019; Frey et al., 2018; Midgley et al., 2017) and to maintain good social relations with their neighbours and other actors in the supply chain. Pressuring growers to grow long-rotation sawlogs forces growers to take on additional risks and face liquidity constraints. The costs of monitoring the forest plantation are higher for longer rotations periods and more technical expertise is needed to grow high quality logs (Zhunusova et al., 2019).

Traders are key actors in the value chain. They are responsible for moving the timber from producers to processors. There are few incentives for them to transport larger logs or to encourage smallholders to grow them. The margins are similar for them whether it is smaller or larger logs. They also don't have the right equipment to handle and transport larger logs and long rotation cycles imply larger transportation costs for harvested wood (Zhunusova et al., 2019). Smallholders value the well-established network of intermediaries that exist for woodchips but are not available for sawlogs (Zhunusova et al., 2019).

2.2.4. Sengon (Paraserianthes falcataria) in Pati, Central Java, Indonesia

Smallholders across the archipelago of Indonesia have a long history of farming with trees, even if initially clearing forests to cultivate food and cash crops. On islands where population centres have continued to grow and there is limited surrounding forests, such as on the island of Java, smallholders often integrate commercial tree crops within their farming system. In other islands, where there is less population growth and there remain extensive forests, there is often little commercial value for smallholders to grow trees for timber. As such, the prospects for smallholders to grow timber for commercial markets vary considerably throughout Indonesia: in remote locations it is often not profitable for smallholders. The rural landscape of Pati district in Central Java (see Fig. 4) reflects the majority of smallholders across Java – the main island of Indonesia, managing integrated farming systems comprised of a mix of annual crops (e.g. rice, cassava), cash crops (e.g. coffee, rubber), livestock (e.g. goats) and trees for timber (e.g. sengon), with most smallholders typically cultivating about a 1 hectare area with secure land tenure (Race et al., 2021). The wet tropical climate with fertile volcanic soils supports a wide range of annual and perennial crops.

In the 1970 s, smallholders in Pati began growing teak (*Tectona grandis*) when encouraged by government programs. However, the anticipated financial gains at harvest were often far below what growers anticipated, so in many cases this land was converted to growing more crops or faster growing trees (Stewart et al., 2021). The government motivated farmers to grow sengon (*'sengonization'*) between 1988 and 1993 and there has been a high demand for sengon (*Paraserianthes falcataria*) timber since the early 2000 s (Irawanti et al., 2017). Interest among smallholders in growing sengon has been increasing since 2010. Sengon has appeal due to its relatively short growing cycle (5–7 years), relative timber strength and stability, ease of silviculture, suitability for understorey crops, ease of harvesting and transport to local processing centres or the larger processing and manufacturing facilities in Semarang. It is also popular among farmers because it can assist in overcoming periods of financial stress thanks to the possibility of harvesting it in a relatively short period, sometimes in just at 4–5 years of planting, much less than other timber species (Irawanti et al., 2014). The timber from sengon is commonly knot-free, pale in colour, light in weight and suitable for low and high-value products – fuelwood, furniture, veneer. A recent estimate is that there are 350,000 ha of sengon grown by smallholders throughout Java (Nambiar, 2019).

2.2.4.1. Smallholder tree growers. The economic context for smallholders living in Pati is largely framed by agricultural production, with a range of annual and cash crops (e.g. rice, coffee) and livestock (e.g. goats) providing the basis of trade in local markets. More valuable cash crops and timber are influenced by the market demand, and the availability of processing and export facilities, in the large coastal city of Semarang (population of about 1.7 million) located about 80 kilometres from Pati. A wide range of agricultural produce, including timber, is processed, and exported domestically and internationally via this bustling city.

Most smallholders have a busy schedule that combines farm-based enterprises and opportunistic off-farm employment or a part-time small business, so growing trees for timber is viewed as an option to passively accrue wealth that can be easily sold to a local broker when needed over a relatively flexible period. Trees with the potential for commercial timber are usually viewed as a 'green' savings account, to be harvested and sold when additional income is needed.

Sengon is mainly grown in agroforestry systems with understorey crops. Seedlings are purchased from the village market or grown from seed provided by the government reforestation programs, but in general farmers are not planting superior seeds (Irawanti et al., 2017). Tree plantings tend to be irregular in spacing, age, height, and growth rate (Irawanti et al., 2017). There is little culture among smallholders for active silviculture of trees once established, as there is a strong expectation that trees will accrue in commercial value with little input required. The lack of silviculture and consequent low quality small volume logs is viewed by many forestry specialists as the main reason why earlier plantations of teak in Pati did not provide the financial benefits anticipated by smallholders, despite recent financial analysis indicating it could still be a profitable enterprise (Stewart et al., 2021). Recent financial analysis also indicates that smallholders can profitably grow sengon in Pati (Stewart et al., 2021).

2.2.4.2. Traders, timber depots, and processors. Farmers in Pati generally sell sengon on a per tree or per area basis at five to seven years of age to a village trader (Irawanti et al., 2017). The price is negotiated before felling and the money is paid to the farmer when harvesting is completed. Several sales are made within a village at the same time so that the trader can aggregate the timber at the village level and save on costs. Village traders organize the harvesting and transporting operations, and have well-established relationships with down-stream buyers, groups of labourers, and truck contractors (Irawanti et al., 2017). Strong competition for sengon timber has encouraged the development of extensive networks of people who coordinate timber supplies for individual sawmills (Irawanti et al., 2014). Traders are key actors in the value chain because they usually pay cash to farmers at harvest and buy individual trees, or plots of standing trees, depending on what the farmer wants (Irawanti et al., 2017).

The timber depot measures log diameters and volumes, and then sorted into different grades (quality), to calculate log value. Logs of different grades are suitable for different types of markets such as jointed boards and plywood. Logs graded for jointed boards and plywood are

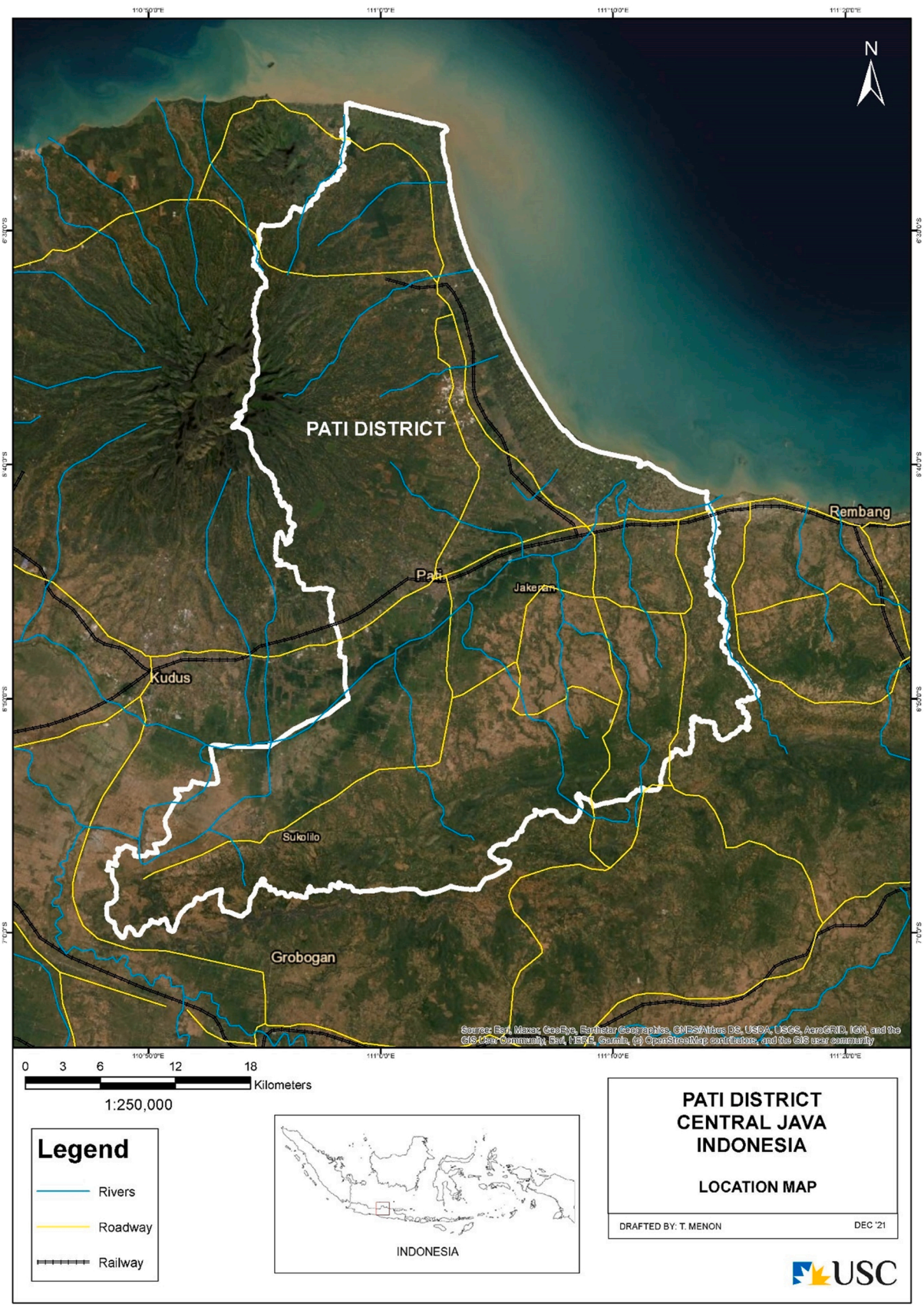

Fig. 4. Location map of Pati district, Java, Indonesia.

sold by the timber depot to the processing industry, with the depot paying for transportation. 'Reject' logs cannot be sold to these markets, but in some cases have been milled by depot owners into products that can then be sold to jointed board factories.

Growers sometimes organize into groups and sell logs directly to processors. These groups are assisted by NGOs to complete inventories that estimate timber quality and volume for each grower. NGOs send inventory data, listing of land to be harvested, and harvesting time frame to the processor on behalf of the grower's group. The processor's representative negotiates prices and who covers harvesting, haulage, and transport costs directly with the growers' group. The processor pays advances so that the growers' group can finance operations. Logs are sorted and separated at roadside into different grades and sizes so the logs can be directed to buyers with specific requirements. This way of organizing production is more profitable for growers, but farmers prefer the less complicated and less risky approach of selling to village traders (Irawanti et al., 2017).

2.2.4.3. Impediments to value chain development. There is strong prevailing demand for farm-grown timber in the province of Central Java which translates into profitable prices for smallholders growing short-rotation species, such as sengon. Although most of Indonesia's round wood supplies come from plantations growing outside Java, much of Indonesia's high-value timber processing and manufacturing occurs on the country's main island – Java. Both sengon and teak have now been planted for several decades by smallholders in Central Java (Permadi et al., 2020), so there is little public concern associated with the harvest and processing of these species in Indonesia. The fertile and wet tropic biophysical conditions allow strong tree growth and the region's infrastructure is sufficiently established to allow affordable transport to, and processing within, the major city of Semarang. Several projects and programs from government and non-government organizations support smallholder forestry but most smallholders are willing to plant trees with minimal financial support.

More knowledge about how silviculture can greatly influence the commercial value of trees at harvest would translate into better prices for growers in Pati. Tree growers expect that unpruned and small diameter teak logs will provide good returns, but this is not the case, particularly when the fixed costs in the value-chain are deducted (e.g., market broker, harvesting and transport, preliminary processing at the local log yard, transport to a large processor and manufacturer) given that the manufacturer is located up to two hours away in Semarang.

Exporting logs and timber products to high-value markets in Europe and the USA faces considerable regulation and verification to ensure international standards of sustainable forest management and legality of ownership are met. Certification of timber from smallholder forests is typically complicated and expensive for farmers and other parties involved, especially when harvesting a small number of trees on an infrequent basis unless the certification process is managed and subsidised by larger businesses or donors (Rohadi et al., 2019). Consequently, smallholders are most likely to continue selling their timber into value chains that yield products for consumption within Indonesia.

3. Results

3.1. Enabling conditions derived from the literature

The enabling conditions identified in the literature review were grouped into the following categories (see Table 2):

- Economic and financial
- Physical and technological
- Human and social capitals
- Regulatory and institutional
- Domestic and international processes

Table 2
Categories of enabling conditions, specific conditions, and literature sources.

Category	Conditions	Sources[a]
Economic and financial	Financial benefits for all value chain agents[b]	Arvola et al. (2020) Boulay et al. (2012) Putzel et al. (2012) Nawir et al. (2007) Zhang and Owiredu (2007) Herbohn et al. (2003) Byron (2001) Godoy (1992)
	Availability of inputs and services for all value chain agents at accessible cost	Iiyama et al. (2018) Baker et al. (2017) Boulay et al. (2012) Nawir et al. (2007) Byron (2001) Godoy (1992)
	Incentives such as tax exemptions, subsidies, payments for environmental services	Arvola et al. (2020) Nawir et al. (2007) Niskanen et al. (2007)
	Complementary markets for thinnings, off-cuts, and small trees	Weersink and Fulton (2020) Sikor and Baggio (2014) Byron (2001) Godoy (1992)
	Presence of traders[c] to reduce transaction costs[d] and provide essential services	Starfinger (2021) Midgley et al. (2017) Perdana and Roshetko (2015) Aoudji et al. (2012) Nawir et al. (2007) te Velde, et al., (2006)
	Availability of financial resources to finance production, harvesting, processing, certifications, standards compliance, technological acquisitions, etc.	Starfinger (2021) Thiele et al. (2011) Trienekens (2011) Altenburg (2006) Pannell et al. (2006) Byron (2001)
	Availability of risk management options for all stakeholders such as insurance, choice of rotation length and livelihood diversification options.	Nigussie et al. (2021) Arvola et al. (2020) Menard and Vellema (2020) Phimmavong et al. (2019) Brancalion et al. (2017) Zylberberg (2013) Trienekens (2011) Altenburg (2006)
Physical and technological	Adequate plot size, number, accessibility, and dispersion	Zhunusova et al. (2019) Jenkin, et al. (2019a) Evans and Turnbull (2004)
	Adequate infrastructure (roads, utilities, waterways, railways, telecommunications, ports)	Jenkin et al. (2019a) Evans and Turnbull (2004)
	Adequate biophysical characteristics of land (rainfall, soil, and topography)	Evans and Turnbull (2004)
	Adequate technologies for planting, production, harvesting, and processing	Iiyama et al. (2018) Nichols and Vanclay (2012) Roshetko et al. (2008) Scherr (2004) Anyonge and Roshetko (2003)
Human and social capitals	Adequate knowledge and skills base for all value chain agents	Ota et al. (2020) Kallio et al. (2011) Pokorny et al. (2010) Belcher and Schreckenberg (2007)
	Presence of producer and other types of organizations	Starfinger (2021) Ochieng et al. (2018) Barua et al. (2014)

(*continued on next page*)

Table 2 (*continued*)

Category	Conditions	Sources[a]
	Community and or peer support for tree production, harvesting, and processing	Sikor and Baggio (2014) Pannell et al. (2006) Byron (2001)
	Strong social connections and relations between agents within and outside the value chain.	Smith et al. (2021) Jenkin, et al. (2019b) Meinhold and Darr (2019) Pulhin and Ramirez (2016)
Regulatory and institutional	Streamlined and consistent regulations for small-scale operations	Sears et al. (2021) Scudder et al. (2019) Maryudi et al. (2017) Smith et al. (2017) Pulhin and Ramirez (2016) Foundjem-Tita et al. (2013)
	Rights to commercialization of forest products	Starfinger (2021) Obidzinski et al. (2014) Foundjem-Tita et al. (2013) Wit et al. (2010) Byron (2001)
	Secure tenure over managed land and trees	Starfinger (2021) Obidzinski et al. (2014) Foundjem-Tita et al. (2013) Wit et al. (2010) Byron (2001) Godoy (1992)
Domestic and international processes	Local, domestic, and global market trends and exogenous events that increase demand for smallholder timber	McEwan et al. (2020) Barua et al. (2014) Midgley et al. (2017) Versteeg et al. (2017)
	Standards and certifications that generate additional benefits without burdensome costs of compliance	McDermott et al. (2015) Atyi et al. (2013) Wiersum et al. (2013) Zylberberg (2013) Putzel et al. (2012) Altenburg (2006)

[a] List is not exhaustive; these are only some of the most representative sources.
[b] Small-scale forestry is widely acknowledged to be a multi-objective endeavour (Herbohn, 2006) in which financial benefits are one of many other goals. However, given that the discussion is around value chains, commercialization, and markets, it is reasonable to assume that a financial benefit is a primary incentive in timber value chains.
[c] Also known as middlemen (although in countries like Laos many are women (Smith et al., 2017)), brokers, or agents.
[d] These are the costs of finding prices, finding potential trading partners, of writing and enforcing contracts with these partners, and of coordinating production (Hobbs, 1996).

This categorization was carried out for ease of analysis but in practice, conditions interact with each other in complex ways (Galloway et al., 2014). For example, physical conditions such as access and road transport conditions will impact on the benefits derived from timber production through harvesting and transportation costs (Freitas et al., 2010). Suitable infrastructure also minimizes financial risks for smallholders because it gives smallholders confidence that there will be access to an outlet for their product (Byron, 2001). Human capital in the form of technical know-how minimizes risk and supports productivity (Flanagan et al., 2020). Some conditions could fit within different categories. For example, subsidies, tax exemptions and payments for environmental services could be interpreted as part of the regulatory environment.

Fig. 5 presents a diagram of a generic value chain with the enabling conditions. Several conditions within the physical and technological, economic and financial, and human and social capital categories are considered part of an initial 'asset base' of the value chain agents (Degrande et al., 2014) (Stoian et al., 2012), hence why they have been located in boxes for each step in the value chain. Conditions within the regulatory and institutional, and domestic and international process categories are considered exogenous. However, these are not rigid boundaries and some conditions such as economic incentives for production may be extrinsic to value chain agents. Value chain agents can also influence the conditions which are exogenous to them.

3.2. Presence and rating of enabling conditions in the case studies

Table 3 offers a visual tool for identifying the presence or absence of conditions in the case studies combined with the importance ratings assigned to each of the conditions for generating current outcomes. The north central Vietnamese provinces and Pati, arguably the most successful cases in integrating, and maintaining smallholder involvement in value chains, displayed consistency in the presence of many conditions. This is indicated by the predominance of green. They displayed most of the economic and financial conditions except complementary markets in Pati. They had all the physical and technological conditions except one partial condition in Pati. Both had presence of all the regulatory, policy and institutional conditions. Luang Prabang and Espiritu Santo have a patchier record of presence, with most conditions partially present or absent.

An overlap of green with rating of 4 or 5 can be interpreted as a strength in the value chain. Examples of this in north central Vietnam and Pati include financial benefits for all value chain stakeholders, inputs and services available at an affordable cost, most of the physical and technological conditions in both cases and all of the conditions within the regulatory, policy, and institutional category. Some of their partial or missing conditions are rated as having medium or low importance. Luang Prabang and Espiritu Santo display a few strength areas such as presence of traders in both; clear rights to commercialization in Espiritu Santo; and adequate infrastructure and domestic and international processes that have positively impacted demand for smallholder teak in Luang Prabang. A combination of red and yellow with importance of 4 or 5 can be interpreted as key areas of intervention to improve current outcomes. There are few of these situations in north central Vietnam and Pati, but many for Luang Prabang and Espiritu Santo. Examples include improving the biophysical characteristics of land where trees are planted in Luang Prabang or increasing financial benefits for all stakeholders in both Laos and Espiritu Santo where smallholders are currently not receiving the desired compensation for their planted trees.

Overall, the smallholder plots in North Central Vietnam and Pati are well-served by roads and close to processing infrastructure and market outlets. Land used to plant the trees has suitable biophysical conditions, although in the Vietnam case, the quality of land has decreased as the land allocation has progressed. Acacias and sengon can be grown with other crops and harvested after 4–6 years to provide short-term returns, making them more attractive for poor farmers with high discount rates. This also reduces risk exposure. Government policies promoting tree planting have been well-timed to coincide with increasing domestic and international demand for timber and woodchips. Consequently, smallholders in both cases are well-placed for tree growing and markets, with continuing interest of farmers in tree-growing. The variability between cases in terms of importance and presence of conditions indicates that understanding the context and elements of each situation needs to be considered in developing policies and programs that are 'fit' for purpose. In the next section, authors elaborated on the key points of intervention for their respective value chain case studies.

3.3. Improving outcomes in value chains through enabling conditions

Better prices for smallholder tree growers in Pati are possible

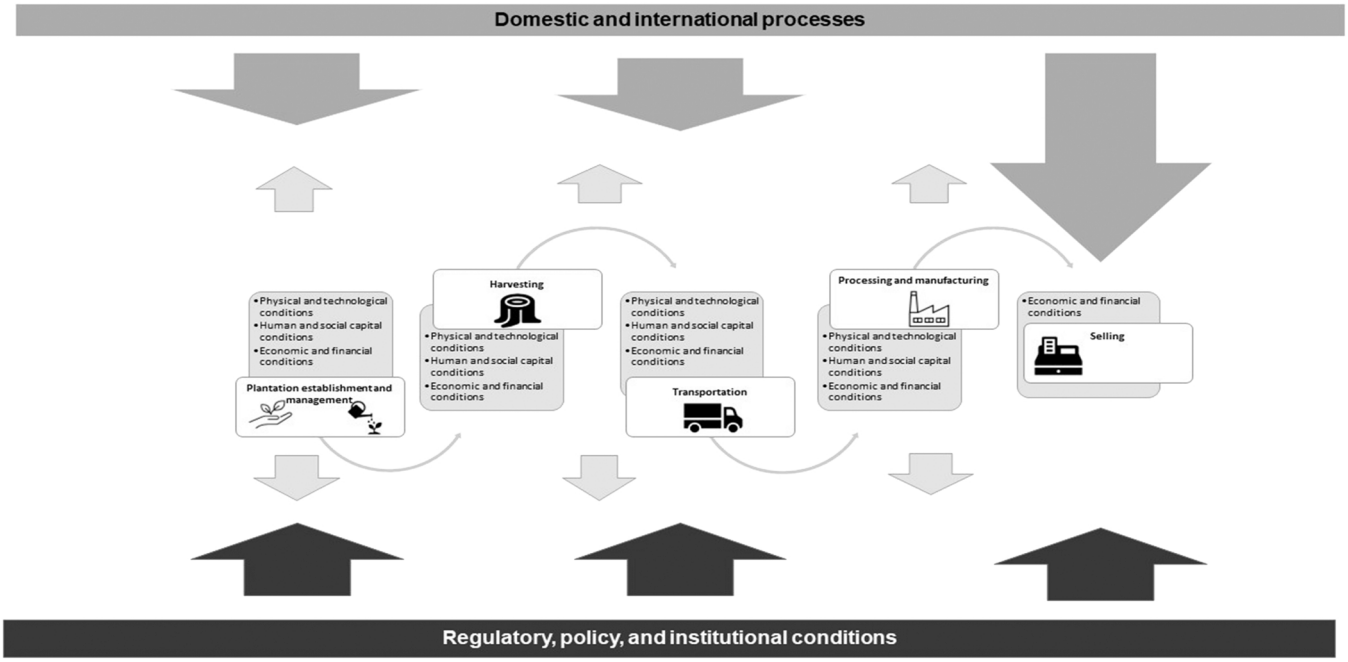

Fig. 5. Generic value chain with enabling conditions (stock arrows show direction of influence to and from the value chain; size of arrow denotes strength of influence; thin curved arrows show direction of flow of the value chain).

through more hands-on training, such as through the Master Tree-Grower (MTG) program in Pati (Muktasam et al., 2019). The MTG has been effective in making silvicultural knowledge and skills much more farmer-centred rather than those pursued by industrial plantation managers. A key feature of this training is taking smallholders into the marketplace so they can better understand how timber is valued, processed and sold along the value-chain and demonstrating that high quality timber in large diameter teak logs can be very profitable for smallholders, even when selling a small number of trees (Stewart et al., 2021) (Irawanti et al., 2017). This knowledge can be used by smallholders to implement the silviculture needed to produce more valuable timber quality and volume. Building this knowledge and sharing it widely among smallholders who grow trees for commercial timber remains a challenge for those promoting smallholder tree growing as a rural development option. In more remote locations (e.g. outside Java), where smallholder forestry is financially more marginal, groups among local growers can make an important difference by increasing access to knowledge and skills, coordinating the input of professional advice and management, improving the efficiency of silviculture, and providing convenient pathways to markets.

In Vietnam a rapidly growing furniture manufacturing industry largely uses imported wood. The government is implementing policies to encourage smallholders to increase rotation length and improve silvicultural practices to grow larger, sawnwood-quality logs, but smallholders continue to prefer growing short-rotation wood for chips. The growing demand for large diameter logs for furniture production could be met through a range of measures such as improving household access to formal credit to support longer rotation management, but its effect on plantation uptake remains uncertain. Lower income households are often hesitant to engage in formal credit programs due to complex processes, high interest rates, complicated bureaucratic requirements, and repayment arrangements that are not linked to the timing of revenues from longer rotations. Many farmers have also indicated concern about their ability to repay loans. Government incentives for longer rotations, such as PM Decision No. 38/2016/QD-TTg which provides US $400/ha[4] for a 10 year-rotation and US$250/ha[5] for 5 year-rotation, should be better publicised as few households have heard of them.

Concerns about risks are also an impediment to smallholders growing longer rotation plantations. Central Vietnam experiences regular typhoons that can cause major damage to forest stands and infrastructure through high winds and flooding. Smallholders are often expected to bear climate or market risks from longer rotations for higher value products. Transferring risks along the value chain and providing information and early payment for higher value logs can support better outcomes for growers and processors. Different forms of joint ventures with processors can empower small-scale growers and improve value chain coordination. Companies needing quality sawlogs could invest to improve ties with smallholders and signal stable future markets and prices by providing technical advice, timber purchase guarantees, loans or cash advances and signed agreements. Log certification could potentially provide a host of additional benefits to growers, retailers, and communities, but the complexity and cost of certification have driven the need to establish artificial 'growers groups' with high administrative costs to engage with certified supply chains (Flanagan et al., 2020; Frey et al., 2018).

In Laos, there has been no recent assessment or advice on biophysical suitability and location in relation to infrastructure and processing facilities. The recently completed railway with its associated dry-ports and roading could improve markets access for some teak growers and processors, but evidence (see Boer, 2019) also suggests that the more accessible land is being converted from teak to other crops. For growers, better site selection, planting, management, and application of silvicultural techniques would have improved tree quality and volume, making it suitable for supplying higher-value product markets. However, for many plantations it may be too late for these interventions. Sympathetic regulation and support for smallholders, intermediaries, and processors on whom they largely depend for market access are needed. While land and tree tenure for teak smallholders are relatively secure, smallholders need confidence that their land use rights will

[4] Approximately 8 M VND/ha
[5] Approximately 5 M VND/ha

Table 3
Presence and importance of enabling conditions in each of the case studies.

Category	Enabling condition	Teak (*Tectona grandis*) in Luang Prabang, Laos	Whitewood (*Endospermum medullosum*) in Espiritu Santo island, Vanuatu	Acacias (*A. auriculiformis, A. mangium, A. mangium ×auriculiformis hybrids,* and *A. crassicarpa)* in Thua-Thien-Hue and Quang Tri provinces, Vietnam	Sengon *(Paraserianthes falcataria)* in Pati, Central Java, Indonesia
Economic and Financial	Financial benefits for all value chain stakeholders	3	5	5	5
	Available inputs and services at affordable cost.	3	3	5	5
	Complementary markets for thinnings, off-cuts, and small trees.	5	2	5	4
	Incentives such as subsidies, tax breaks, payments for environmental services.	3	3	5	2
	Presence of traders	5	4	5	4
	Financial resources for production, harvesting and processing	3	4	4	3
	Risk management options for all stakeholders such as insurance, choice of rotation length and livelihood diversification options	3	3	4	3
Physical and technological	Adequate plot size, number, accessibility, and dispersion	3	4	4	4
	Adequate Infrastructure (roads, utilities, waterways, railways, telecommunication, ports)	4	4	4	4
	Adequate biophysical characteristics of land (rainfall, soil, and topography)	4	5	5	5
	Adequate technologies for production, harvesting, and processing	2	5	5	3
Human and social capital	Adequate knowledge and skills base	2	4	3	3
	Presence of producer and other types of community organizations	4	5	3	3
	Community and/or peer support for tree production, harvesting and processing.	2	4	5	3
	Strong social connections and relations between agents within and outside the value chain	3	4	4	5
Regulatory and institutional	Streamlined and consistent regulations tailored to small-scale operations.	4	5	5	4
	Clear rights to commercialization of forest products.	5	5	5	4
	Tenure security over managed land and trees	5	5	5	5
Domestic and international processes	Global, regional, and local market trends and events that increase demand for smallholder timber.	5	3	5	5
	Standards and certifications that generate additional benefits and with which it is easy to comply.	1	4	2	2

Present (green), Absent (red), Partial (yellow); 5 very important, 4 important, 3 medium importance, 2 low importance, 1 insignificant

continue if they adopt improved management strategies and rotational harvest systems. This can be supported by extension to improve understanding of plantation management requirements for improving tree and wood quality as is happening in Pati, Indonesia. Reforms that enable grower groups and enterprises to contract and aggregate wood supply, negotiate on price, and innovative, flexible, and low risk cash-flow management solutions could help increase interest in growing teak.

A priority in Espiritu Santo is for processors to set prices to reflect the costs and conditions for growing plantation timber without attempting to hoard value away from smallholders. Markets for thinnings would incentivize the application of optimal silvicultural practices, increase the financial returns of planting for farmers, and yield returns earlier in the growing cycle. Early and/or more frequent returns are needed to provide investment security and flexibility in harvesting within the limits of market capacity. Absence of a market for plantation grown logs in the form of processing capacity that requires different processes and equipment to the conventional native forest resource, is a primary bottleneck to capturing returns and further plantation establishment in Vanuatu. In addition, future plantation establishment should be planned so that the available estate is located near processors or new processing facilities established in areas with a degree of woodlot concentration. Harvesting woodlots will be more economical to portable saw millers when woodlots are close together, due to a reduction in cost of moving the portable mill between woodlots.

4. Discussion and recommendations

The previous analysis revealed that strategies to develop viable timber value chains around smallholder tree growers must be based on an understanding of both 'demand-pull' and 'supply-push' factors. The 'field-of-dreams' model of forest industry development which might have worked for large-scale state plantation investments, is not the right option for smallholders. Encouraging planting without specific end-uses leads to plantings that are of little use to industry, to frustration for smallholders, and represent a general waste of resources (Evans and Turnbull, 2004).

Processing of high value timber products is generally capital intensive and requires a threshold scale of resource to justify investment therefore strategic land use planning is essential (Smith et al., 2021). Special attention must be paid to demand tendencies, infrastructure, smallholder capabilities and interests, as well as the biophysical suitability of an area. Adequate planning improves the chances the market will be there when the trees achieve maturity, that prices will be attractive, and that transportation costs will be low, but timber yields high (Obidzinski and Dermawan, 2010). It also facilitates the tasks of quantification and establishment of inventories of smallholder supply of commercial wood which are crucial for making efficient investment decisions such as what size and where to locate processing plants. The importance of these issues is typically underestimated by decision and policy makers. Biophysical suitability is fundamental, yet there are many examples of plantation trees being grown in unsuitable land (see Brancalion and Holl, 2020, Obidzinski and Dermawan, 2010, Evans and Turnbull, 2004). Specific characteristics of potential sites must be surveyed before implementing new tree planting programs (Kallio et al., 2011) and selected species matched to land conditions. Short rotation wood where timber quality and large diameters is not crucial is a good starting point that fits well with risk-averse smallholders of limited physical, financial, and human capital resources (Arvola et al., 2020). Our study indicates that regions with high human population, proximity to processing and shipping infrastructure, and higher quality road networks which enable woodlots to be commercially utilized offer the most opportunity for generating financial value for value chain agents.

Within one country, conditions vary widely to the point that policies are unlikely to have homogeneous results at the national level. Decentralizing and designing flexible policy for implementation at a local level are better than general national strategies or blanket policies (Chang and Andersson, 2021; Smith et al., 2021). The policy environment should be clear, stable, and consistent with policies for tree growing aligned with those of related sectors such as agriculture and manufacturing (Smith et al., 2021). The aim of policies and programs to support smallholder tree growing should be to identify catalytic interventions, work with existing or near-term market drivers and streamline regulations in the value chain such as approvals to plant trees, or harvest or transport timber. Nevertheless, the role of the state in value chains continues to be contested, and can vary widely depending on citizen expectations, history, and economic system among other factors (see Neilson, 2014, Smith et al., 2021 Horner, 2017 , Dwyer, 2016, Cramb, 2016).

There does not appear to be any kind of spontaneous growth in grower groups in any of the cases in this study. This is surprising considering the amount of literature supporting cooperatives as providers of market access for small-scale producers (see for example Poulton et al., (2010), German et al., 2020, Markelova et al., 2009). Possible reasons uncovered in other case study research include scepticism of cooperatives based on the historical legacy of experiences with communal farming under communist regimes, group formation driven by donors and the government, ongoing dependence on external actors to sell wood, lack of tangible benefits from participation in these groups, increased administration, and regulatory barriers to group formation (Ling et al., 2018). There are lessons to be learnt from the experiences of group formation in other countries and crops, such as the coffee sector in Indonesia (see Vicol et al., 2018), the rubber sector in Laos (see Smith et al., 2020), the timber sector in Vietnam (see Le et al., 2022) and generally see Hintz et al. (2021) for a global review. As recommended by Hellin et al. (2009), a flexible approach informed by an understanding of when these organizations make sense and when they do not, who is in the best position to promote them, and how they can be best established and maintained is best.

Traders and buyers at the farm gate are formidable competitors for producer organizations (Vorley et al., 2012) and this is clearly reflected in our case studies where traders are fulfilling at least some of the roles usually performed by these organizations. Traders are often viewed as detrimental to smallholder value chains; consequently, many policy interventions are often designed to work against them. However, with the right measures in place traders are effective and essential and rather than pushing them out, introducing measures to draw them into formal value chains may be more effective (Maraseni et al., 2018).

Our analysis supported the need for smallholders to have secure land and tree tenure to engage in tree growing. In Pati, Indonesia and North Central Vietnam, government policies to clarify and formalise land tenure and use rights and allocate more state land to households for tree growing has given smallholders confidence to grow trees and support development of value chains. On the other hand, policies aimed at encouraging tree growing by granting tenure and land use rights to those who planted trees had unintended consequences in Laos where planting trees was a means for farmers to secure land, rather than grow timber (Smith et al., 2017). This continues to affect perceptions about tenure security and the flow of quality timber towards processing.

Silviculture and technical packages are an important part of the human capital necessary for enabling smallholders to grow the right kind of trees and produce good quality wood for the market. However, the case studies reveal that the transfer of knowledge continues to be problematic. Many smallholders are unconvinced about the benefits of investing more of their capital in tree and plantation management and applying silvicultural techniques commonly used in commercial plantations to improve stand value, such as thinning and pruning. Farmer-focused training courses, such as the MTG program in Pati, which informs smallholders about how different silvicultural approaches are reflected in market prices, can change behaviour (Muktasam et al., 2019). In some situations, regulations can limit the ability for smallholders to generate benefits from intermediate products (ACIAR, 2017). Regulatory changes that allow smallholders to easily generate benefits from intermediate products such as thinnings, are necessary for

extension efforts to be successful (Pachas et al., 2019).

5. Conclusions

Long-term regional and global demand for plantation grown wood indicate that opportunities for smallholders to supply commercial wood are on the rise and are likely to remain stable (see McEwan et al., 2020, Flanagan et al., 2020). Organizations that promote tree planting and advise tree growers must consider the findings of this paper to improve chances of success for these tree growing ventures. Government policies, regulations and support programs can accelerate the development of smallholder forestry if these can be combined and targeted to the specific regional (sub-national or provincial) context. A nuanced rather than uniform approach to policy implementation at the regional level is likely to be more effective – making policy 'fit for purpose'. We call attention to our finding that regions with high population areas close to relatively large urban centres and well-served by different types of infrastructure appear to offer better conditions for viable timber value chains to flourish around smallholder tree growers.

Not all smallholders participate in tree growing for the primary purpose of producing wood. Expectations that all will be willing and enthusiastic timber value chain actors must be tempered by an understanding of the context in which they choose to plant, harvest, and sell their trees and the role trees play in their broader livelihood strategies. Informing smallholders about commercial forestry value-chains may enable them to think differently about their options and make timely decisions that respond to market signals. This will help move commercial forestry towards being an integral and sustained enterprise among the portfolio of enterprises that smallholders typically manage. Developing a viable and self-sustaining industry for smallholder forestry should also include awareness and engagement of all key actors along the value-chain, so that the role of actors at each stage is understood and fine-tuned, and smallholder forestry becomes increasingly seen as an industry worth investing in for sustained benefits.

CRediT authorship contribution statement

Dora Carias: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Tony Page:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision, **Hilary Smith:** Formal analysis, Investigation, Writing – review & editing. **Digby Race:** Formal analysis, Investigation, Writing – review & editing. **Rodney J. Keenan:** Formal analysis, Investigation, Writing – review & editing. **Graeme Palmer:** Formal analysis, Investigation, Writing – review & editing. **Jack Baynes:** Methodology.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2022.106227.

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