Improving *Acacia* smallholder plantation value chains in Thừa Thiên Huế cooperative alliance, Vietnam

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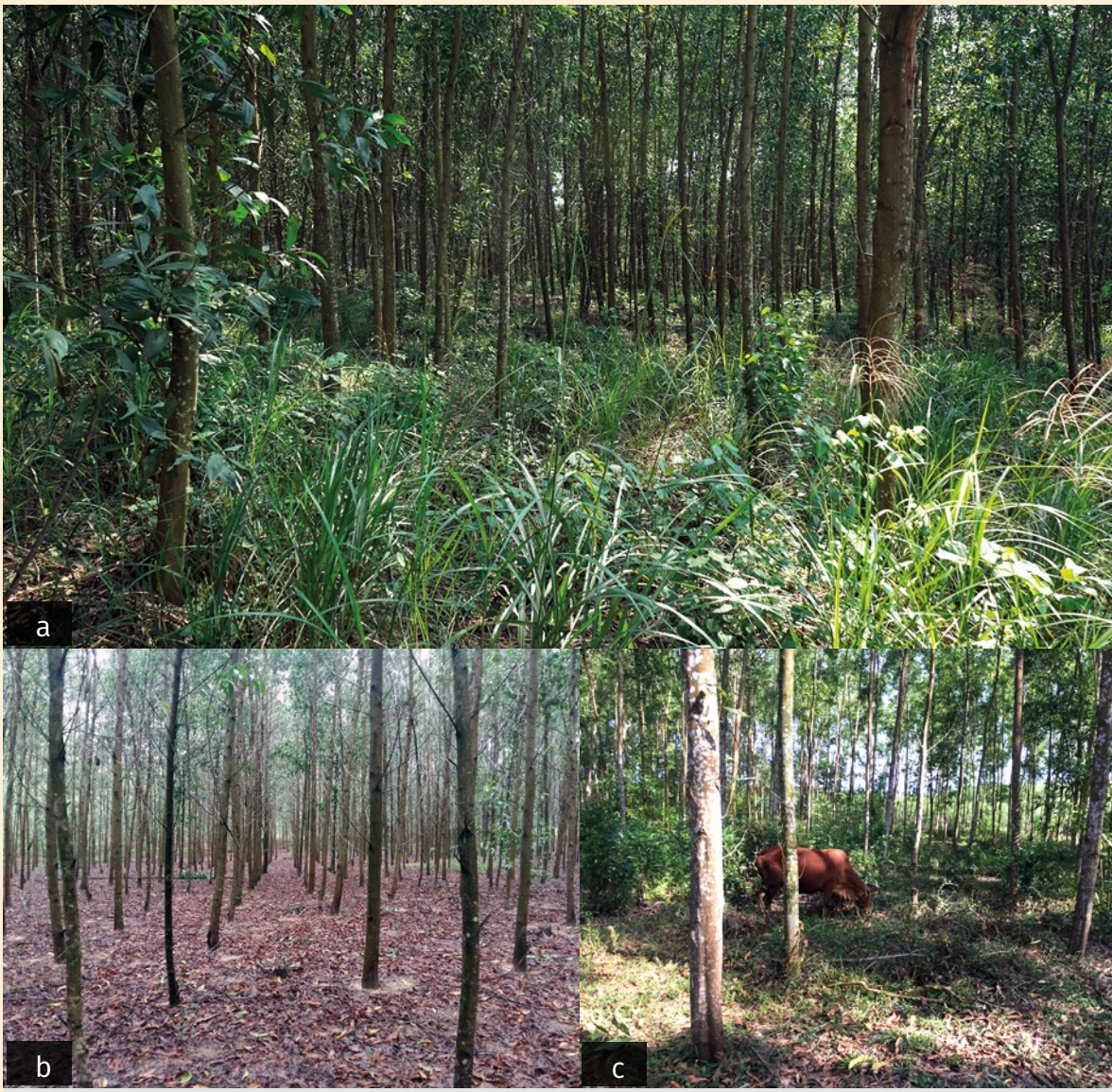

Photos 1.
Acacia plantations during the humid season (a), the drought season (b), and with the possibility of grazing cattle (c). The plantations are composed of young trees with small diameters.
Photos T. Ha Ho.

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RESEARCH / *ACACIA* PLANTATION VALUE CHAIN ANALYSIS

RÉSUMÉ

Amélioration des chaînes de valeur pour les petites plantations d'*Acacia* dans le cadre de l'alliance coopérative de Thừa Thiên Huế, Vietnam

Les plantations d'*Acacia* au Vietnam jouent un rôle important dans l'approvisionnement de l'industrie de transformation du bois et la création de revenus pour les petits propriétaires forestiers. Cependant, il s'avère difficile d'améliorer leurs revenus et de réduire les vulnérabilités inhérentes aux systèmes de production actuels. Pour remédier à cette situation, une analyse quantitative et qualitative des chaînes de valeur a été entreprise pour comprendre les produits et les bénéfices des petites plantations d'*Acacia* dans la province de Thừa Thiên Huế au Vietnam. Les résultats montrent que les plantations d'*Acacia* sont rentables, ne nécessitent que peu d'intrants et ont une durée minimale de rotation de cinq ans seulement. Les coûts d'extraction et de transport représentent une part importante des coûts de production totaux. Les négociants ont un rôle important dans la mise en relation des producteurs et des transformateurs. La plupart des produits commercialisés sont des grumes d'*Acacia* destinées aux scieries pour déchiquetage et transformation en d'autres produits, et pour la production de bois de charpente et d'usage domestique. Les grumes d'*Acacia* d'un diamètre supérieur à 15 cm ont davantage de valeur ajoutée pour les entreprises de transformation du bois qui produisent des meubles destinés à l'exportation. Les vulnérabilités découlent de la chaîne de valeur très fragmentée, peu coordonnée et proposant peu de mécanismes d'échange d'informations, et des différends entre groupes ethniques qui suggèrent la nécessité d'intervenir sur les chaînes de valeur de manière culturellement sensible. Les différentes options pour augmenter les bénéfices – en particulier pour les petits propriétaires de plantations – comprennent la diversification des productions, l'intégration de la chaîne et une augmentation de la production pour une meilleure efficacité d'échelle.

Mots-clés : *Acacia*, petites plantations forestières, analyse des chaînes de valeur, certification volontaire de durabilité environnementale, coopérative, Vietnam.

ABSTRACT

Improving *Acacia* smallholder plantation value chains in Thừa Thiên Huế cooperative alliance, Vietnam

Acacia plantations in Vietnam have an important role in supplying the wood processing industry and generating income for small-scale forest owners. However, it is proving difficult to improve their incomes and reduce the vulnerabilities inherent to current production systems. To address this situation, a quantitative and qualitative value chain analysis was undertaken to understand the products and profits from small-scale *Acacia* plantations in Thừa Thiên Huế province in Vietnam. The results show that *Acacia* plantations are profitable, require low levels of inputs and have a short minimum rotation time of five years. Harvesting and transport costs account for a large proportion of total production costs. Traders play an important role in linking producers and processors. Most of the products traded are *Acacia* logs for chipping and processing into other products and for saw-wood to produce timber for carpentry and domestic uses. *Acacia* logs with larger diameters of over 15 cm have a higher added value for wood processing companies producing furniture for export. Vulnerabilities include the highly fragmented value chain with little coordination and few information exchange mechanisms, and differences between ethnic groups that suggest a need for culturally sensitive intervention on value chains. Different options to increase profits – particularly for smallholder plantation owners – include product diversification, chain integration, and increased production to achieve efficiencies of scale.

Keywords: *Acacia*, smallholder forest plantations, value chain analysis, voluntary sustainability certification, cooperative, Vietnam.

RESUMEN

Mejora de las cadenas de valor para plantaciones de *Acacia* de pequeños propietarios en la alianza cooperativa de Thừa Thiên Huế, en Vietnam

Las plantaciones de *Acacia* de Vietnam juegan un papel importante en el suministro a la industria de transformación de la madera y en la generación de ingresos para los pequeños propietarios forestales. Sin embargo, resulta difícil mejorar estos ingresos y reducir las vulnerabilidades inherentes a los sistemas de producción actuales. Con el objetivo de remediar esta situación, se emprende un análisis cualitativo y cuantitativo de la cadena de valor para comprender los productos y los beneficios de las pequeñas plantaciones de *Acacia* en la provincia de Thừa Thiên Huế, en Vietnam. Los resultados muestran que las plantaciones de *Acacia* son rentables, requieren bajos niveles de insumos y tienen un tiempo mínimo de rotación corto, de cinco años. Los costes de recolección y transporte representan una importante proporción de los costes totales de producción. Los comerciantes juegan un papel importante al poner en contacto a los productores con los transformadores de la madera. La mayor parte de los productos comercializados son troncos de *Acacia* para astillar y transformar en otros productos, y para producir madera aserrada para carpintería y usos domésticos. Los troncos de *Acacia* con diámetros grandes, de más de 15 cm, presentan un elevado valor añadido para las empresas transformadoras de madera que producen muebles destinados a la exportación. Entre las vulnerabilidades se encuentran la cadena de valor altamente fragmentada, con poca coordinación y pocos mecanismos de intercambio de información, y las diferencias entre grupos étnicos que aconsejan una intervención culturalmente sensible en las cadenas de valor. Las diferentes opciones para incrementar los beneficios – en especial para los propietarios de pequeñas plantaciones – incluyen la diversificación del producto, la integración de la cadena y un aumento de la producción para alcanzar mayor eficiencia de escala.

Palabras clave: *Acacia,* plantaciones forestales de pequeños propietarios, análisis de cadena de valor, certificación de sostenibilidad voluntaria, cooperativa, Vietnam.

Introduction

Vietnam has become one of the major global woodchip exporters in the past 15 years. In 2002, the country exported approximately 150,000 tons of woodchips. By 2015, the export of woodchips, mainly from planted *Acacia* species (*Acacia mangium* and *Acacia* hybrids), reached 8.1 million tons (Phuc et al. 2013). *Acacia* species are preferred for woodchips due to their fast growth, rotation period, and higher profits compared to other tree species, including those in natural forests (Kien and Harwood 2017). About 80% of plantation woods are used for woodchips production (Maraseni et al. 2017). Up to the end of the 1990s, forested land in Vietnam was converted into agricultural land to cultivate rice, tea, or livestock. However, since around 2002, small-scale farmers have expanded the area of forest plantations, planting on previously deforested agricultural land (Sandewall et al. 2010). By 2014, 12.6 million ha (79.7%) of the total forestland have been allocated to individual households (4.4 million ha), government organizations including state forest enterprises (5.2 million ha), enterprises (2.2 million ha), and other entities including communes (0.8 million ha) (MONRE 2014). Government organizations largely manage special use and protection forests for conservation, with planted production forests mostly allocated to households and economic entities (Nguyen and Masuda 2018). By 2015, planted forests in Vietnam accounted for about 26% of the total forest area (Maraseni et al. 2017), with approximately 46% of that area managed by individual households and smallholders (Nambiar et al. 2015). The national forest development strategy to 2020 promoted the expansion of plantation forests coupled with third-party forest certification, including groups of smallholder farmers (Auer 2012). The forestland allocation policy has led to numerous small-scale farm forests being managed by ethnic minorities, reduced the area previously managed by state forest enterprises, and limited the availability of arable land in mountainous regions. To respond to this scarcity, under Decision 178/2001, the Ministry of Agriculture and Rural Development allowed barren forestland owners to use up to 20% of their allocated areas for agricultural annual crops (Nguyen and Masuda 2018). The national policies encouraging afforestation and timber promotion have also created employment, increased household income, and led to increased exports of plantation products, especially *Acacia*-based products (Auer 2012).

Small-scale plantations in tropical countries have generally been seen as a means of reducing illegal logging, meeting the fuelwood needs of the rural poor, reducing pressure on natural forests, thereby contributing to their conservation, and allowing local people to choose how they allocate land, capital, and time to growing trees (Harrison and Herbohn 2001). However, smallholder plantation forest owners face problems related to the temporality of employment, which only occurs during planting and harvesting; difficulties finding private and public investment capital to establish plantations; income returns occurring only after harvest; and land tenure conflicts between the government, enterprises, indigenous people, and local people (Auer 2012; Cossalter and Pye-Smith 2003). Marketing timber from small-scale plantations can be difficult for smallholder owners due to their relative lack of power and market information, the small quantity of timber they offer, the low uniformity of products, and the continuity of supply (Auer 2012; Harrison and Herbohn 2001). Given the importance of smallholder *Acacia* plantations in supplying the Vietnamese processing industry and export markets, the problems faced by smallholders, and the lack of data on their options to improve their income and position in the value chain, this study seeks to fill this knowledge gap.

The majority of forested land in Vietnam is in the Northeast, North Central, and Central Highlands (MARD 2020). Thừa Thiên Huế is the southernmost province of the North Central Coast region, where 70% of the total land area of 505,398 ha is categorized as forest land, mainly in the mountainous western area, where socio-economic conditions have long been less developed (Minot 2006) and poverty affects 30% of households (Grimm et al. 2016). These highlands have been targeted by the government for social, economic, and environmental development, on the assumption that the forestland can be suitably and sustainably developed.

Acacia species have been increasingly planted throughout Thừa Thiên Huế province since 1998, when a 5 million ha programme was implemented (Ha 2008). By the end of 2019, the forest area of the province was 311,206 ha, of which 99,833 ha were plantation forests. Thừa Thiên Huế is among the provinces with the highest forest coverage in Vietnam. Plantation forests have increased the province's forest coverage from 43% in 2003 to 57.27% in 2019 (MARD 2020).

The majority of the population in the Highlands are ethnic minorities (Kozei 2014), who have different farming and cultural traditions related to land use than the Kinh (Viet) from the lowland coastal region, who comprised 85.3% of the national population in 2019 (GSO 2020). After the decollectivization of agriculture, communities were given household forest land use rights, where they have generally practiced subsistence agriculture (Minot et al. 2006; Castella et al. 2006). The Kinh have historically engaged in wet rice cultivation in plains areas, and ethnic minorities in shifting cultivation (Castella et al. 2006). Currently, *Acacia* products (woodchips and timber) provide the main source of income for many households in this area. However, smallholder *Acacia* plantation owners face difficulties in increasing their income due to a lack of knowledge of silviculture techniques, the value, and markets for *Acacia*-based products (Ha, 2008) (photos 1).

To overcome these problems, many smallholder plantation owners are members of cooperatives (Castella et al. 2006). The Vietnam Cooperative Alliance (VCA) (2019; 2020) is the non-governmental socio-economic organization at the

apex of the Vietnamese cooperative movement. The Thừa Thiên Huế Cooperative Alliance (TTHCA) is a member of the VCA. Established in 1994, it brings together 18,000 members of 256 farmer cooperatives in the province. Of these, about 5,000 farmers in 128 cooperatives are also plantation forest owners, owning on average two to three hectares (ranging from 0.3 to 30 ha). A total estimated 30,000 ha of forested land belongs to members and the cooperatives. Given increasing requirements for third-party sustainability certification, such as Forest Stewardship Certification (FSC) or the Program for the Endorsement of Forest Certification (PEFC), for timber destined for the export market, TTHCA and its members risk a reduction in income if they are uncertified and unable to sell to the lucrative certified export market (Maraseni et al. 2017; Hoang et al. 2019).

Given this context, the aim of this study is to understand the value chain flowing from TTHCA smallholder plantation owners from the production and trade of *Acacia*-based products, the economic costs and benefits in the chain, and the options to sustainably increase benefits, particularly for smallholder owners.

Photos 2.
Carpentry and joinery factory using big timber for furniture (a) and woodchip factory using small timber (b), the main processors of the wood raw material.
Photos T. Ha Ho.

Methods

A two-step value chain analysis (Kaplinsky and Morris 2001) was conducted. The first step was to determine the inputs and outputs of *Acacia* products and also to calculate the incremental value of each product by determining the value of their outputs. The value chains emerging from the plantations were then mapped, leading to the identification of two *Acacia* products (woodchip and timber for furniture), which were differentiated according to their diameter and uses (woodchips or timbers) (photos 2).

Data collection

To ensure a representative sample and to strengthen the results, the Probability Proportional to Size method (Schmitz 2005) was applied. From the total target group of 256 cooperatives in TTHCA, three districts (Huong Thuy, Phong Dien, Phu Loc) were selected based on the criteria of their geography (flat, hilly, or mountainous) and distance from the factory (near and far) (table I). These districts share similar soil characteristics, with the predominant soil type being Ferralsol, characterised by a medium to thin topsoil, uniform texture, and rocky, degraded, and low-quality soil. From each selected district, three cooperatives where at least 40% of members-owned plantations were selected. In each selected cooperative, 30 *Acacia* plantation-owning households were then randomly sampled for interviews. All households agreed to be interviewed. In total, 270 households (225 Kinh and 45 minority households) were interviewed in 2019 to obtain qualitative and quantitative data about their demographics, plantation production, harvesting, and transportation activities, costs and inputs, including own and hired labour, and income for the years 2016 and 2017. Following the value chain, using snowball sampling methods, 20 traders buying *Acacia* wood products, 15 sawmill owners, 22 carpenters, 5 woodchip mills, and 2 large processing companies in Thừa Thiên Huế province were identified and interviewed. These interviews covered demand, production capacity, values, and the volume of wood processed in Thừa Thiên Huế province. A focus group discussion with invited farmers, traders, processors, and exporters yielded information to verify and cross-check individual interview data and deepen understanding of the value chain activities and actors. Data on exporters and their customers were not included in the scope due to accessibility limitations.

Data analysis

Qualitative information from surveys was synthesized to determine some factors affecting the production process and to investigate interrelations between components in the value chain of production of *Acacia* products and analysed using basic statistics to describe the current situation.

Quantitative data were analysed and processed using SPSS (Statistical Package for the Social Sciences) and EXCEL software to describe differences between factors and to assess economic indicators of production and consumption.

Table I.
Characteristics of selected districts and cooperatives.

District	Situation	Cooperative/Commune
Huong Thuy	Flat	Thuy Phuong
	Good transport conditions	Phu Bai/ Thuy Phu
	Close to furniture factories	Thuy Phu/ Thuy Phu
Phong Dien	Flat and hilly	Hoa My/ Phong My
	Poor transportation access	Phong Son
	Far from factories	Phong Chuong
Phu Loc	Hilly and mountainous	Loc Tri
	Poor transport access	Loc Tien
	Close to woodchip factories	Loc Hoa

Comparisons of Kinh and indigenous householder plantation owner members of the Thừa Thiên Huế Cooperative Alliance (TTHCA) were made using common economic indicators: total cost, total income, net income, net present value (NPV), profit (gross margin, difference between total income and total costs), the cost-benefit ratio (CBR), and internal rate of return (IRR). Economic efficiency is measured using cost-benefit analysis (CBA) using three indicators: net present value (NPV), internal rate of return rate (IRR) and the benefit cost ratio (BCR). Data are provided in Vietnamese Dong (VND). According to the State Bank of Vietnam, the average exchange rate at December 2019 was 1 US$ = 23,160 VND.

Results

Value chain activities and actors, costs and benefits

The qualitative and quantitative data are presented, which describe the *Acacia* value chain actors, activities and products, and associated costs and benefits of activities.

The *Acacia* product value chain from Thừa Thiên Huế province

Figure 1 highlights that the *Acacia* value chain segments are distinguished according to tree diameter, and then used for two main products: furniture and woodchips. Eight types of actors engage in this chain.

Traders (93%) and woodchip processing companies (5%) together consume an estimated 98% of standing *Acacia* and peeled *Acacia* logs supplied by growers, giving them a strong position of power in determining the subsequent products and prices (photos 3). Data on the total volume of products further down the chain from processing companies and carpenters could not be estimated because of the diversity of products, large numbers of actors, and small production volumes. The nature of the chain is highly fragmented (Los et al. 2015) with little integration and specialization by different actors in different activities. Smallholders capture limited value as they are not involved in adding value in segments such as trading, processing, milling, or carpentry. There is little coordination and information exchange between actors along the chain in terms of quality, technical specifications, forward planning for demand, investment, credit, or input supply.

Smallholder *Acacia* farmers

On average, the TTHCA *Acacia* farmers own 2.5 ha of *Acacia* plantations per household, ranging from 0.3 ha to 30 ha, with a standard deviation of 0.28. Most farmers

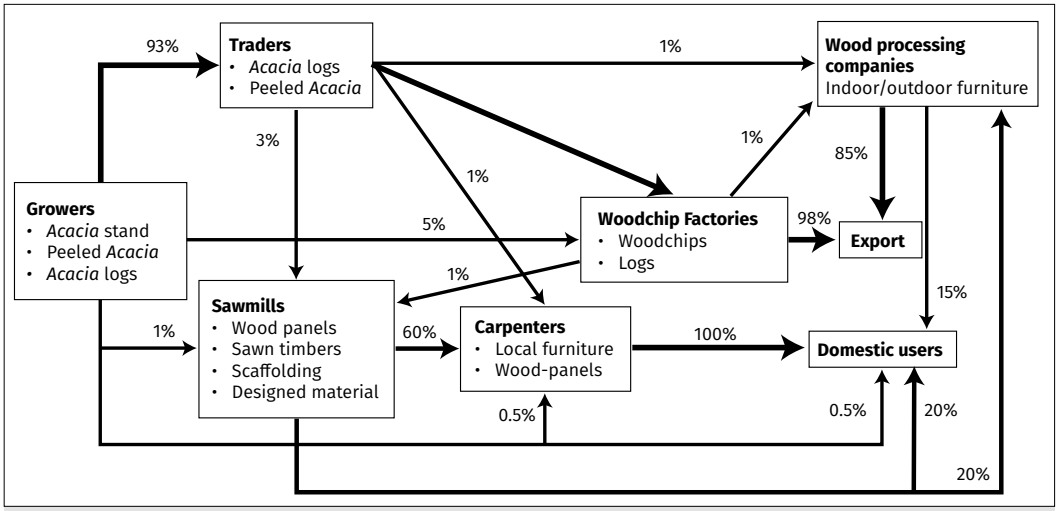

Figure 1.
Actors and position in the *Acacia* value chain from Thừa Thiên Huế province key: % indicates the percentage each actor supplies to the total value chain.

planted *Acacia* because of its high perceived profit (98%), low cost (93%), available market (90%), simple production techniques (61%), short production cycle (60%), suitable soil condition (30%), and to aid soil improvement (17%). This indicates that farmers were more concerned with short-term profitability than soil fertility, a motivation to plant *Acacia* often promoted by scientists (Nambiar et al. 2015), representing an aspect that appears less understood by farmers. None of the interviewed farmers or cooperatives had third-party sustainability certification, although there were about 5,000 ha of plantation forests in the province certified by FSC in 2019.

Farmers generally sell to traders (93%) and woodchip factories (5%), with sawmills, carpenters, and local users together accounting for 2%. All (100%) of the minority households sold their forest stands to traders; however, some Kinh householders conduct harvest and transport to sell *Acacia* logs to woodchip factories or sawmills. Mainly standing *Acacia* trees and peeled *Acacia* logs are sold to traders, with large diameter *Acacia* logs sold to sawmills or carpenters. A small percentage (0.5%) of residual products (such as bark and small diameter branches) are used as firewood or sold to local users.

Traders

About 93% of *Acacia* products traded by the cooperative members in the province are sold to traders. The average investment capital of traders was about 180 million VND, which purchased about 3 hectares of standing *Acacia*. Capital sources for traders varied and included own capital (80%), bank loans (15%), and friends (5%). *Acacia* stands were the main product purchased by traders. *Acacia* stands were preferred to logs and other species for a number of reasons. Unlike the strongly regulated timber species in protection and conservation forests, *Acacia* is classified as a production forest product and can be legally harvested, easing business and its legitimacy, which is a major factor for traders entering the forestry trade. Compared to other timbers, *Acacia* wood is generally sold in shorter cuts (from 1-3 meters long). This makes it easy to handle and transport.

Traders largely sell debarked, peeled *Acacia* logs (95%) or unpeeled *Acacia* logs (5%). Peeled *Acacia* was sold only to woodchip factories, whereas unpeeled logs had a larger market, and were sold to sawmills, carpenters, and wood processing companies for indoor or outdoor furniture and other consumer end-use products.

Woodchip and wood processing companies

The five woodchip mills and two wood processing companies surveyed in the province were joint-stock companies or joint ventures with foreign capital. Traders are the biggest source of timber (95%) for woodchip factories. The factories buy about 5% of their *Acacia* supplies directly from farmers. *Acacia* grown in other provinces is also sold to these factories through traders. Woodchip factories buy only peeled *Acacia* by the ton. The main output product (98%) is woodchip exported internationally, mainly to China, Thailand, Japan, and South Korea.

Photos 3.
Peeling of *Acacia* trunks (a, c) after the logging as short logs (b), stocked on the parcel edge.
Photos T. Ha Ho.

About 2% of large-diameter, peeled *Acacia* logs are resold to sawmills or wood processing companies for furniture or other end-use products.

Demand from the large and open export market for *Acacia* chips in Asia and government policies have been decisive factors in the success of these companies. Prior to 2019, these companies received incentives from the government and support from policies, such that all products from production forests were exempt from export taxes. Compared to other timber species, *Acacia* plantations have been well supported by the Vietnam government and foreign investment projects, creating the current large supply of raw materials. Since the technical requirements for *Acacia* chip production are not very complex, production is suitable for unskilled workers, the majority of whom are local farmers. In contrast, the technical and procedural requirements for certified logs are more complex and costly.

Indoor and outdoor furniture companies purchase *Acacia* logs from woodchip factories, traders, and especially from sawmills, where they order pre-cut material. The majority of their purchases is processed timber, with raw or semi-processed material accounting for only a very small proportion of purchases (10%). The main export markets for 85% of total products are European Union countries and the USA, with 15% of products sold domestically.

Sawmills and carpenters

Sawmills and carpentry workshops are located in almost every district in the province. However, official information on their numbers and trade is not available. They are supplied with timber from *Acacia* farmers and traders. Sawmill final products include sawn boards sold to carpenters, scaffolding for use in conventional construction, and packaging materials for factory and company goods and supplies. 60% of sawmill products are sold to carpenters, who sell their popular and diverse end products, such as home furnishings, doors, and furniture, all to local users.

Added value channels for *Acacia* products

There are two main channels where added value is accrued in the *Acacia* value chain from Thừa Thiên Huế province, distinguished by the size of *Acacia* logs and resulting processing as woodchips or furniture. These channels are not independent but interrelated by different log diameters, which are used for different purposes and products. The log diameter is determined by the age and silvicultural management of the plantation. To better understand the profitability of each product type and chain actor, the added value of each segment in the value chain is calculated on a per hectare basis. In one hectare of five-year-old *Acacia* plantation, approximately 5% to 10% have a diameter greater than 15 cm, which is used for timber, and the rest (90%) is used for wood chips. The incremental value at each stage is shown in figure 2.

Channel 1 and 2 both start with *Acacia* logs with a diameter greater than 15 cm and involve the same actors in product processing. The difference is between the end users. On average, about 5 to 10% of the *Acacia* volume harvested is 15 cm diameter or more (about 8 m^3/ha), which is usually sold to sawmills. Sawmills indicate that from 1 m^3 of *Acacia* logs, they produce 0.5 m^3 of sawn timber, 0.375 m^3 of offcut material, and the remaining 0.125 m^3 is comprised of sawdust and other defective materials. *Acacia* logs are purchased for about 1.6 million VND/m^3. Sawn timber is sold at 3.6 million VND/m^3 in 2019, and offcut material for 700,000 VND/m^3. Offcuts are often sold to local users as firewood or sold to factories to make woodchips. Sawn timber is sold directly to carpenters or interior and exterior woodworking companies for further processing. Products made by carpenters are sold to local users, while around 85% of interior and exterior wood products made by woodworking companies are exported, and 15% are sold to local consumers. Sawdust is often used as firewood or is disposed of as waste because the size of most sawmills and carpentry shops is too small to economically make products from sawdust.

Channel 3 commences with *Acacia* timber of less than 15 cm diameter. The trunk is cut into 2-meter-long pieces and peeled, after which it is sold directly to woodchip mills for export. Woodchip mills have a processing loss of 0.9%, of which 0.8% is in the form of sawdust, which can be sold for heating or to medium-density fiberboard (MDF) factories. Therefore, the total loss from processing is 0.1%. Woodchips are not dried prior to export, but the sale price is based on dry woodchips. The moisture content of wood chips largely depends on tree age and tree size, on average being 48 to 50% fresh weight. Wood moisture content is checked by random sampling by Vinacontrol, so that the total volume of absolute dry wood for a shipment can be calculated. A ton of *Acacia* wood chips was sold on average for 120 US$ or 2,779,200 million VND/BDMT (bone dry metric ton) in 2019 at the port of exit (FOB) price.

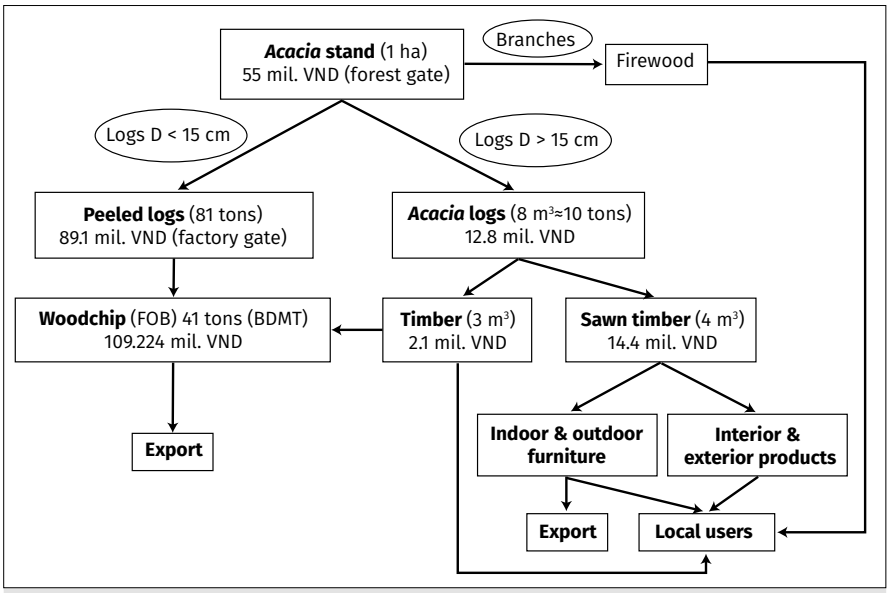

Figure 2.
Value adding in the *Acacia* value chain from Thừa Thiên Huế province.

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Costs and benefits of *Acacia* plantations for owners

Acacia is the main tree species (95% to 97%) planted by TTHCA members. The costs of production are strongly affected by the rotation cycle, which depends on the purpose of the plantation. *Acacia* was planted by 90% of members intended for woodchips on a production rotation cycle averaging five years. Factors affecting costs are the different farming habits of Kinh and minority householders. Kinh householders practice intensive plantation cultivation, where land is prepared carefully and fertilizer applied in the first two years, while the minority group householders generally practice extensive cultivation with trees planted in a hole and no or little fertilizer application. Seven main activities occur in the production cycle, as indicated in table II, along with their costs.

Although there is little difference in the total costs of *Acacia* plantations between Kinh and minority householders, there is a large difference in the costs of each plantation activity. In general, Kinh householders had higher costs for fertilizers (applied in the first 3 years), land preparation and protection (forest fire prevention and fighting, thinning and weeding, and pest management), and lower costs for harvesting and transportation. These differences are attributed to Kinh householders generally being closer to main roads and their plantations being more accessible, with less steep slopes than those owned by minority households. Harvesting and transportation costs are the highest costs incurred, accounting for 57% to 70% of total costs. On average, the costs of harvesting each hectare of *Acacia* are between 10 and 23 million VND, on average 16,700 VND/m² (0.72 US$/m²); and between 5 and 10 million VND, on average 9,000 VND/m² (0.39 US$/m²) for transportation for Kinh households, but for minority households, the costs for harvesting are between 12 and 25 million VND, on average 18,700 VND/m² (0.81 US$/m²) and transportation costs are between 8 and 15 million VND, on average 11,700 VND/m² (0.51 US$/m²). The costs vary depending on the location of the plantation. Consequently, most minority group households do not usually conduct harvesting and transportation but sell standing trees to traders, who harvest and transport them to mills and carpenters. All the costs are deducted from the buying price, which reduces the profitability of the plantations for owners.

The economic indicators of *Acacia* production for TTCHA householders are shown in table III. In general, *Acacia* plantations have high economic efficiency. Kinh householders earn higher profits compared to minority householders. As costs for both groups are similar, the main explanation for the higher profit is the higher volume of *Acacia* products sold. Productivity in the intensive production method favoured by Kinh households entails fertilizer application and silviculture techniques; the extensive method used by minority households depends strongly on the availability of land and other natural resources to maintain soil fertility. These findings suggest an intensive cultivation model is more economically profitable given the current limited availability of land for plantations. This finding also suggests that minority households, because of the extensive cultivation method generally practiced as a cultural habit, create a financial disadvantage.

Table II.
Average costs of *Acacia* plantation activities per hectare for Thừa Thien Huế Cooperative Alliance (TTHCA) members in 2019.

Activity	Kinh households		Minority households		Average	
Costs (1,000 VND)	**Average**	**Standard error**	**Average**	**Standard error**	**Average**	**Standard error**
Land preparation (labour)	2,850	320	2,250	640	2,750	373
Seedling purchase	2,250	640	3,510	820	2,460	670
Planting (labour)	1,250	225	1,650	725	1,317	308
Tree care and protection (labour)	6,200	1,250	2,800	1,150	5,633	1,233
Fertilizers	5,450	1,050	1,800	950	4,842	1,033
Harvesting (labour and materials)	16,700	6,250	18,700	6,750	17,033	6,333
Transportation	7,350	2,350	11,700	3,550	8,075	2,550
Total	**42,050**	**12,085**	**42,410**	**14,585**	**42,110**	**12,502**

Discussion

A major finding is that the intensive plantation model favoured by Kinh households produces the highest net income for smallholder owner members of the TTHCA. However, based on the value chain analysis, changing production systems presents one option for households to increase income and profits. For households with insufficient investment capital, a semi-intensive model before transitioning to the intensive model could be used, where short-term intercropping of cassava, corn, legumes, etc., in the initial one to two years allows efficient land use, improves soil fertility, and provides an early income stream in the first years of afforestation – which can partly cover initial production costs. This agroforestry practice has been successfully applied in various provinces in Vietnam, including coconut-cacao intercropping in Ben Tre, litsea-cassava (*Litsea glutinosa* intercropped with *Manihot esculenta*) in Gia Lai, rubber-cassava (*Hevea brasiliensis* intercropped with *M. esculenta*) in Thừa Thiên Huế, and *Acacia*-cassava (*Acacia* sp. intercropped with *M. esculenta*) in Phu Tho (Mulia et al. 2018). Additionally, this recommendation is informed by experiences with agroforestry systems involving *Acacia* in other parts of the world (Deng et al. 2017; Lua et al. 2013; La et al. 2015). Other possibilities include capital assistance in tree growing and mainte-

nance and assistance in the period between planting and harvesting (Nawir et al. 2007). Changing to more intensive models, however, is anticipated to result in higher and more negative environmental impacts – such as the more intensive use of fertilizers impacting water and soil quality in ecologically fragile areas, the effects of clear-cutting land use cover on soil erosion, particularly on steep slopes, potential fire risks, and the introduction of monocultures reducing agricultural and forest biodiversity (Ingram et al. 2016). These costs were not quantitatively nor economically valued in this analysis but are critical to consider in terms of overall and landscape-scale costs and benefits. Following the practices embodied in sustainability certification schemes could partially mitigate these impacts (Auld et al. 2008; Iwanaga et al. 2019; RESOLVE Inc. 2012).

A second option to increase household income and profits is to use different *Acacia* subspecies. The use of hybrid clones could result in timber with a larger diameter compared to the current *Acacia* species (*A. auriculiformis* and *A. mangium*) given the same rotation period. This would increase the proportion of larger-diameter logs for saw logs, and the manufacture of indoor and outdoor furniture for domestic consumption and export, which is a more profitable segment of the chain. This would also be in line with the government's promotion of quality timber to meet its 2020 furniture export targets (Maraseni et al. 2017). To further improve income, trees should be grown for at least 6 years. Lee et al. (2022) indicate similar results given hybrids in stands of 7 years. Extension services are required to support the transition and adoption of enhanced silvicultural management techniques, greater risk tolerance, and longer timescales for returns on investment (Po et al. 2023).

Given the low level of coordination and information exchange, creating a barrier to align the demands for products with the smallholder supply of timber meeting specific technical and quality, a third opportunity is to structurally change activities in the chain. Common value chain upgrading strategies to do this are to shorten the chain and cut out intermediaries (Humphrey 2004). If households harvested, peeled, and sold directly to sawmills or processors (woodchip plants, furniture factories), they could capture more value, manage costs themselves, and avoid intermediary costs. Investments in such expertise, training, and equipment are however generally needed to conduct these activities to meet customers technical and quality requirements (Humphrey and Schmitz 2000), particularly for sustainable certified timber, and extension services can aid the adoption of new practices (Po et al. 2023). The cooperative could play a key enabling role here. A side effect would be the exclusion of intermediaries from the chain, resulting in a loss of income for them.

A fourth alternative is to enhance the use of collective action and the power of cooperative members. Farmers could increase returns by selling residues to woodchip mills, particularly if they offer this collectively so that the larger volumes are more attractive to buyers, or by secondary processing, such as into briquettes for fuelwood, chipboard, laminate, etc. Agricultural and forestry extension services to cooperatives could be strengthened to provide supporting technical services, especially focusing on seedling quality, plantation maintenance, processing, and market information services. Collectively organised transport could lower costs, particularly for farmers further from customers and located on challenging terrain. Attention to the different practices and contexts of the different ethnic groups, and exchanges, could also enhance the benefits of minority owners. As access to land is a major limiting factor, especially for minority groups, policies that address this issue, while taking into account other land uses – notably maintaining food security and conservation of natural forests – could play a role in addressing inequalities in benefits gained by different ethnic groups in the *Acacia* value chain. As members of cooperatives, smallholders could relatively easily form labour exchange groups to aid land preparation, care, management, protection, harvest labour, and finance group transportation. This could reduce production costs, improve income and quality, and access to different markets for different products. Cooperatives with sufficient capital, technical knowledge, and management skills could also consider adding value to *Acacia* timbers and diversifying into processing products. Such groups could also be ways to exchange experiences on improved silviculture techniques such as thinning, fertilizer application, and insurance to cover the costs and risks of longer cycles (Maraseni et al. 2017) and to strengthen their negotiating position with mills and chip processing companies (Nawir et al. 2007).

Fifthly, collective action at other segments in the value chain could also result in efficiencies in scale and increase competitive advantage (Humphrey and Schmitz 2000). Where land conditions make harvesting difficult, traders could be organised to transport and sell peeled logs. Measuring and classifying large (over 15 cm) diameter logs targeted as timber for sawmills and wood processing factories would benefit both farmers and traders due to the higher value of large logs.

A sixth opportunity is to enhance links between stakeholders in smallholder chains to empower and enhance their position in the value chain (RTI, IIRR

Table III.
Economic indicators of *Acacia* production per hectare for Thừa Thien Huế Cooperative Alliance (TTHCA) members.

Economic Indicators (1000 VND)	Kinh Households	Minority households	Average
Total cost over 5 years	42,050	42,410	42,110
Total income over 5 years	98,700	81,200	95,783
Profit (gross margin)	56,650	38,790	53,673
Net income from acacia per year	11,330	7,758	10,735
Net present value (NPV)	34,972	23,909	33,128
Benefit-cost ratio (BCR)	2.35	1.91	2.27
Internal rate of return (IRR)	47%	46%	46.5%

2012; Helmsing et al. 2011; Henriksen et al. 2010). Increased communication and improved information flow between the apex cooperative, the cooperatives and their members, sawmills, carpenters, and wood processing factories on their quality and diameter requirements and demand can result in more effective markets that also advantage smallholders. As the price for certified *Acacia* wood products is higher when exported for use in furniture, poles, boards, and planks in Europe and America, initiatives supporting smallholder group – certified sustainable forest management – can be beneficial for smallholders and others in the export chain (Hoang et al. 2015), as long as the full costs of certification are shared among stakeholders in the chain and not disproportionally borne by smallholders (Auer 2012; Hoang et al. 2015; Hoang et al. 2019). Apart from achieving higher value, stakeholders in the chain can benefit from the cooperation and information exchanges that commonly occur as part of certification (Ingram et al. 2016).

Seventh, the results suggest other upgrading strategies that improve efficiency, and add value by recycling and reusing waste could be explored. Currently, sawmills and paper mills are the main producers of residues, some of which are used as firewood. Sawdust and chips can be used in a variety of secondary products, such as MDF (medium-density fiberboard), fiber-, chip-, and particle-boards, laminates, pellets, and compressed sawdust briquettes (Wildayana 2016), paper, moulding, charcoal, household crafts (Dirkswager et al. 2011) and gums (Seigler 2002) to enhance returns and efficiency.

Conclusion

Acacia is the most common and preferred species for smallholder landowners, producers, and traders, with The Thừa Thiên Huế Cooperative Alliance (TTHCA) member's *Acacia* plantations in Thừa Thiên Huế province, in Vietnam. *Acacia* plantations occupy 30,000 ha of forestland, equivalent to 29.8% of the planted forest area of the province. Smallholder farmers are generally highly dependent on their plantations, which generate 40% to 50% of household cash incomes, and *Acacia* plantations generate profits of on average 54.5 million Vietnamese Dong (VND, Vietnamese money) and an annual income of on average 10.9 million VND for rural cooperative members, with a positive cost-benefit ratio and high internal rates of return of between 45 and 50%. The costs of *Acacia* plantations can be recovered in a relatively short period of five years, and so they are favoured as the main land use and source of income by landowners in Thừa Thiên Huế province. The economic costs of intensive and extensively cultivated plantations are similar, with higher benefits related to increased productivity of intensive cultivated plantations.

The *Acacia* value chain originating from members of the TTHCA in Thừa Thiên Huế province has six main actors: smallholder farmers, traders, woodchip mills, wood processing factories, sawmills, and carpenters. The nature of the actors, the structure, organisation, and governance of the value chain create vulnerabilities, particularly for smallholder owners. The chain is highly fragmented with little vertical integration, such that smallholder farmers are not involved in trading, processing, milling, or carpentry. Different land use practices and governance systems between ethnic minority and Kinh farmers suggest a need for culturally sensitive value chain interventions. There is little coordination, and information exchange enables demand and supply to be matched or communicates technical and quality requirements, such as sustainably produced timber and products, between actors along the chain. Traders play an important role in linking smallholders to wood processing plants where a variety of end-products, from chips to furniture, are produced, exported, and also sold on the Vietnamese domestic market, where most *Acacia* products are semi-finished. While demand for *Acacia* has grown, the growth rate to enable a continuing supply of the raw material is not known. Seven main options exist to address different activities and actors in the value chain. These include adding value for different actors along the chain, diversifying products and increasing production, and increasing the economic and environmental sustainability of the value chain for different actors, particularly small-scale owners and their cooperatives. However, to implement such options to enable sustainable and equitable value-adding, and to provide evidence for more effective policymaking, sharing information on not just economic costs and benefits for different actors but also on social and environmental implications is needed. Stakeholders in such decision making include the government, forest enterprises, cooperatives and their members, and certification standards organizations. Studies on the risks of high dependence on mono-species plantations from a livelihoods perspective – in terms of income but also energy, nutrition, and food security – and from an ecological viewpoint (such as risks of pests, diseases, and fire; impact on soil and water quality and on erosion on steep slopes) and possibilities to reduce risks and increase income, such as through diversification, as well as a comparative assessment of the environmental costs of intensive and extensive small-scale plantation forestry, are recommended.

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Availability of data and material
Data are available upon request.

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