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1 Acknowledgments

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2 Executive summary

As many smallholders already know, a successful forestry enterprise takes much more than growing trees. Reflecting the complexity of community-based commercial forestry (CBCF), the project explored the economic, institutional, market, policy, silviculture and social components of smallholder forestry in Indonesia. The project team collaborated with tree growers, market brokers and contractors, company owners and field staff, program managers and policy makers, industry analysts and researchers, to understand a wide range of perspectives about what makes CBCF successful in Indonesia.

Given that Indonesia is such a diverse country and the opportunities for CBCF vary widely, the project team focused its effort in five districts with very different characteristics: Bulukumba (South Sulawesi), Gunungkidul (Yogyakarta), Pati (Central Java), South Lampung (Lampung) and Boalemo (Gorontalo). Where there is strong demand for a range of timber products (e.g. sawn boards, veneer, furniture and appearance timber), such as throughout much of Java, Bali and Sumatra – with major centres of urbanisation (economic development) that have a growing population of more than 500,000 people (Indonesia has 27 cities with >500,000 people) – CBCF appeals to many smallholders. Timber grown by smallholders is mostly sold into local and provincial value-chains, whereby smallholders usually sell their standing trees to local market brokers, who in turn organise the harvesting, transport and preliminary processing, or transport to large integrated processors and manufacturers. Species, timber quality and volume mainly determine the price offered to growers, with prices generally satisfying growers if they are living in close proximity of competitive markets. In rural areas that are remote from economic hubs, commercial timber production is often not very profitable for smallholders compared to commodity (e.g. cassava, rice) and cash (e.g. coffee, rubber) crops.

Smallholders typically view CBCF as a relatively passive enterprise compared to most agricultural enterprises, with little effort given to pruning or thinning trees as a forest grows. However, with appropriate silviculture at key stages of a tree's growth, CBCF could be a much more profitable enterprise for smallholders. For example, analysis shows that a small forest of sengon (*Paraserianthes falcataria*) could generate an internal rate of return (IRR) of 20% and a small forest of teak (*Tectona grandis*) could generate an IRR of 15% in Central Java, if well managed.

A poor understanding of silviculture (tree management) by smallholders is frequently reported to undermine the potential commercial returns from CBCF. To address this gap in knowledge and skills, the project team adapted the Master TreeGrower (MTG) training course to the Indonesian context and delivered 15 training courses, with additional courses self-funded and delivered by Indonesian agencies. Over 400 smallholders have undertaken the MTG's innovative training offered by the projects of FST/2015/040 and FST/2008/030, which has a focus on increasing growers' understanding of local markets, tree management and measurement, the link between silviculture and prices, risk management, agroforestry and non-timber forest products. Post-training evaluation indicated that more than 50% of MTG participants changed the way they managed their forests and had planted additional trees with more confidence in their silviculture and commercial value. Adopting a gender-sensitive approach saw equal numbers of men and women undertake MTG training, and gave more women the confidence to share their experience with CBCF among their networks of family and friends. Strengthening the social networks of smallholders is important for raising the general level of knowledge about CBCF and producing timber of higher value, and creating realistic expectations of what a fair price is for their produce among the local community (see Appendix 1: Summary of key findings).

3 Background

The area of forests and the number of people involved in community-based commercial forestry (CBCF) in Indonesia is believed to be vast and increasing. While nearly 400 million ha of forest was estimated to be under community control or management in 2001 (including areas not necessarily formally recognised as community forestry), this area was expected to increase to about 740 million ha by the year 2015 – directly involving about 300 million people (Bull and White, 2002). More recent figures indicate that more than 80 million people are forest-dependent in Indonesia alone (Poffenberger, 2006). Despite the enormous scale of community forestry, several experienced analysts have expressed doubt about the magnitude of the social benefits that have been achieved (Obidzinski and Dermawan 2010; Maryudi *et al*., 2015; Gilmour 2016).

This project sought to increase the understanding about how to enhance the benefits of CBCF for smallholders and Indonesia's private sector, thereby increasing the positive impacts from CBCF. For example, the previous project (FST/2008/030) focused on CBCF on privately-owned farmland (*hutan rakyat,* HR) and did not conduct any in-depth analysis of the potential to increase the adoption of CBCF by smallholders using state-owned land (*hutan tanaman rakyat,* HTR). This project expanded the range of study sites to include CBCF on private farmland and state-owned land leased to local communities. Another research gap identified for this project was that there was no comparative analysis of CBCF options with other land-use options.

As with many countries with a diminishing area of tropical forests, the Indonesian government is under pressure to reduce deforestation, increase the plantation estate to supply the timber industry, and to reduce rural poverty – with community forestry selected as the dominant strategy to achieve these multiple goals. In 2009, the Indonesian government launched a major strategy to involve local communities in commercial forestry with the Peoples' Plantation Forests (known in Indonesia as *Hutan Tanaman Rakyat*, HTR) program. Its aim is to foster close community involvement in commercial forestry across 5.4 million ha – an ambitious target given that it would double the then total area of Indonesia's forest plantations and need to involve 360,000 rural families, who each would be managing an average of 15 ha of forest (planted or natural).

The government has also recently set a target of establishing 12.7 million ha of more general community-based forestry, so local communities are actively engaged as managers and owners of forests as a strategy to reduce forest fires, land tenure conflict and illegal forest activities. In addition, CBCF is also intended to provide communities with access to forest resources, as another means of improving their welfare. While Indonesia has an ambitious policy goal for CBCF it faces considerable challenges with program implementation and the variable capacity at the local level (e.g. smallholders and district extension staff being uncertain of the commercial value of CBCF, smallholders having limited understanding of commercial forestry markets, inadequate resourcing of extension services to support CBCF in rural areas).

Establishing a vibrant CBCF sector is widely viewed by policy makers as a strategy to assist smallholders build productive and sustainable farming systems that include a diverse and resilient 'package' of commercial opportunities. An estimated 15 million smallholders manage more than 1.5 million ha of planted forests across Indonesia, with two of the most important commercial tree species being teak (*Tectona grandis*, often grown on 15-30 year rotations) and sengon (*Paraserianthes falcataria*, often grown on 5-7 year rotations). While small-scale forestry is commonly an integrated component of family farms, for example comprising about 30% of farm income in Java, most smallholders fail to realise the full commercial potential of the trees they plant or appreciate the market specifications that impact on log quality and value (Irawanti *et al*. 2014). This situation is more acute for smallholders who tend to harvest timber and non-timber forest products (NTFPs) opportunistically from state-owned land and sell into low-value local markets.

The Indonesian government is increasing its ambition for CBCF, both in terms of economic activity and rural livelihoods. However, there is currently a complex regulatory process for smallholders to follow before they can legally trade their forest products without a market broker. The regulatory complexity discourages smallholders from engaging directly with forest markets, diluting the 'signals' they receive about how different silvicultural options correspond to market specifications. As such, most smallholders follow traditional silvicultural practices with little regard for the market's demand for specific product length and quality. Also, poor smallholders tend to have more limited social networks and links to market brokers, than wealthy smallholders – further constraining the capacity of CBCF to alleviate rural poverty in Indonesia. This project aimed to explore some of these complex barriers to CBCF in Indonesia so that the benefits might be realised by a greater proportion of rural and regional communities, local economies and the environment.

The project explored both smallholder forestry on private land (HR) and community management of forests on state-owned land (HTR), that together account for the majority of CBCF across Indonesia. The project's applied research approach meant the project team worked closely with smallholders in the five study sites (10 villages) and processors that purchase most resources from farmers (e.g. local sawmills), staff from District and Provincial agencies, field officers from NGOs, and other researchers with an interest in CBCF. The study sites were selected using the following criteria:

- locations targeted for expansion of farm-based wood production by the private and public sectors (including forests within concession areas recently re-allocated for local community management);
- have species widely used in commercial forestry by smallholders (e.g. acacia, sengon, teak, NTFPs);
- have different market pathways for CBCF (with preliminary analysis undertaken in the previous project FST/2008/030);
- are at different stages of industry development (establishment to mature plantations, established & expanding forest industries, small & large-scale processors); and
- are likely to yield important lessons for the scaling-out of CBCF to other regions of Indonesia (on private and state-owned land).

The project's overall strategy was to engage smallholders, the private sector, government agencies and other relevant stakeholders (e.g. NGOs) to identify the most effective ways for CBCF to provide increased income to smallholders, more reliable high-quality supplies of timber for industry, and achieve the additional policy goals of government.

The nature of the research approach was trans-disciplinary, combining qualitative and quantitative data and analysis, to provide greater precision in how to enhance the policies and practices that shape the outcomes of CBCF.

While clearly interested in seeing CBCF become a viable rural industry, the project team was not seeking to become advocates or promoters of CBCF to smallholders. The project team was very mindful of being independent researchers, with the emphasis on building the capacity of smallholders so they can critically appraise the commercial opportunities in CBCF and form the business partnerships that they need with the private sector.

4 Objectives

This project aimed to identify how commercial forestry can increase the incomes of smallholders, and scale out the broader benefits of commercial forestry to local communities and industries. The project was organised around addressing three objectives, in turn answering key scientific and policy questions noted below:

Objective 1: To enhance the commercial benefits from CBCF for smallholders by strengthening their business networks.

Activity 1.1: Conduct a baseline economic and social dimensions study (Lampung and Gorontalo) and an in-depth social network analysis at each study site to identify the business networks used by different smallholders, and build on the strengths of the different networks;

Activity 1.2: Convene workshops with smallholders in each study site (HR and HTR sites) to explore how they can strengthen their links with the relevant private sector partners;

Activity 1.3: Analyse the relative value of feasible land-use options for smallholders (e.g. agroforestry, planted forests, NTFPs, cash crops, REDD+) in the study sites, and identify optimum land-use strategies to increase household income;

Activity 1.4: Work with private sector and NGO partners interested in forest certification to assess the value of different schemes promoted for CBCF and applicability across different land tenure (e.g. the FSC, LEI and SVLK 'certification' schemes that operate in Indonesia's forestry sector);

Activity 1.5: Prepare succinct guidelines for smallholders that explain the requirements for different forest certification schemes.

Objective 2: To increase the capacity and number of smallholders able to make informed decisions about their silvicultural approach and likely returns from CBCF.

Activity 2.1: Analyse recent experiences of pilot Master TreeGrower (MTG) training courses (conducted under FST/2008/030) to design an effective approach and training materials for CBCF extension;

Activity 2.2: Conduct 15 MTG training courses with FFGs in the study areas (3 MTG courses in each of the five provinces);

Activity 2.3: Design and implement a pilot of a 'Farmer-to-Farmer Mentoring' (F2FM) program to achieve the effective scaling-out of the CBCF experiences to neighbouring FFGs.

Objective 3: To analyse the policy context for CBCF and support policy reform that enables it to become a profitable investment choice for smallholders.

Activity 3.1: Conduct a 'foresight' analysis of the major trends occurring in rural Indonesia and their implications for CBCF;

Activity 3.2: Conduct interactive workshops that translate the 'foresight' analysis into contemporary policy settings (national, provincial & local levels);

Activity 3.3: Review the factors that influence the success (Lampung) and constraints (Gorontalo) of the government's HTR program that aims to foster CBCF on state-owned land;

Activity 3.4: Undertake an analysis of policies, programs and regulations that influence the adoption and viability of CBCF, integrating analyses of the government and private sectors and engaging senior policy makers and program managers, and trial 'policy lab' approach;

Activity 3.5: Facilitate a multi-stakeholder discussion forum every six months in each study site to exchange CBCF experiences and discuss emerging research findings.

The project developed a 'monitoring and evaluation rubric' (M&E rubric) (attached as Appendix 2) as a process to critically assess the project's performance on a regular basis. The M&E rubric was designed to largely be a self-assessment tool to stimulate discussion and reflection among the project team, so the project team could be proactive in adjusting and refining activities, events and/or strategies. The appeal of the project's M&E rubric has been illustrated by its approach being adopted by several other ACIAR projects.

5 Methodology

The project's overall methodology was an applied science approach, whereby research questions were developed and explored in a 'real world' context. That is, the research was pursued with close engagement with a wide range of partners who were identified as having deep experience relevant to the specific research questions. Many of the research questions had a focus on smallholder (farmer) experiences of commercial forestry – positive and otherwise – as a source of data and more general information that was used for analysis of policies and programs, for trialling new approaches to forestry extension, for constructing financial and land-use models, and developing appropriate strategies for influential engagement during the project's 5-year period. Given the project was also interested in the value-chains or pathways to market for smallholders, the project team engaged important actors in the private sector (e.g. sawmill managers/owners who sourced much of their supplies from smallholders). Lastly, the policy context for CBCF in Indonesia is invariably complex and variable between the five tiers of government and across the 34 provinces – with overlapping regulations and responsibilities relating to smallholder forestry. As such, the project team actively engaged with relevant staff from different government agencies at the national, provincial and district levels. The project's methodology could also be referred to as a 'grounded theory' approach, where existing theories of causality and prior experience leads to researchers being able to develop the research questions and refine the methodology when in the field (across diverse 'real world' settings) in an iterative process. The research methodology was not designed to be an 'action research' process, but rather a 'participatory research' approach whereby a wide range of stakeholders were involved to provide data, share their experiences, review emerging results and implement recommendations.

The project was a collaborative effort between the following partners:

- Forestry and Environment Research Development and Innovation Agency (FOERDIA) – Ministry of Forestry and Environment, Bogor and Makassar;
- Universitas Gadjah Mada, Yogyakarta;
- University of Mataram, Mataram;
- Trees4Trees (Indonesian NGO), Semarang;
- Australian Agroforestry Foundation (Australian NGO); and
- University of the Sunshine Coast, Sippy Downs, QLD.

The project collected a wide range of qualitative and quantitative data, designed to be appropriate to answering the specific research questions. Even when the key research questions were carefully considered and expressed in the project's design, the data collection process was often far from being a straightforward process. For example, growth yield data for two of the most commonly planted trees species in Indonesia, sengon (*Paraserianthes falcataria*) and teak (*Tectona grandis*), proved very difficult to obtain and verify, which led to a lengthy delay in the project's modelling work as original tree plot data had to be collected and verified before realistic growth yields could be developed. Also, contracting local enumerators for the project's Social and Economic Dimensions (ESD) Household survey led to discrepancies and variations in data collected for quantitative and qualitative metrics across the five study sites, and between the collection years of 2013, 2017 and 2020, which required considerable effort and time to adjust, verify and harmonise the data among the project team.

The project's five study sites included the rural districts of Gunungkidul (Yogyakarta), Pati (Central Java) and Bulukumba (South Sulawesi) where strong partnerships had been established by the project team since 2005. The project also included two new study sites in the districts of Boalemo (Gorontalo, northern Sulawesi) and South Lampung (southern Sumatra) where there are emerging and established sites of CBCF on state-owned land (HTR), with all study sites indicated below (see Figure 1).

Figure 1: Location of study sites in Indonesia

Gunungkidul – has an established culture amongst smallholders for growing trees for commercial timber production, with a competitive market for a range of forest products traded by smallholders. However, increasing urbanisation and demographic change in rural communities has created a trend of ageing farmers (young adults moving away to cities for education and employment), reduced availability of farm labour, conversion of farmland to more intensive land-use (e.g. sites for new housing and industry) and more extensive planting of trees on farmland – reflecting a trend to less intensive farming. Yet it is uncertain whether the increasing area of farm forests will receive the necessary silviculture to produce high-quality supplies for industry. The project continued to work with local partners in the three villages in Gunungkidul to conduct the longitudinal ESD household survey, assess the value of different market pathways, evaluate and refine the MTG training courses, pilot the F2FM approach, and explore the policy context for CBCF.

Pati – is dominated by small-scale farmers, most with just 0.5 – 2 ha of farmland, with integrated agricultural and forestry enterprises, mainly supplying local and provincial markets. Over the past decade, sengon (usually maturing in 5-6 years) has become an increasingly popular timber species grown by smallholders, traded to a variety of processors within the province who in turn produce plywood for national and international markets. Some processors produce Sustainable Forest Management (SFM) certified plywood, creating a niche market for smallholders to be paid a premium price (10-30% higher prices) if they are able to meet the SFM certification requirements. The project explored the feasibility of the certification market and the value different certification systems offer to smallholders within the province, and elsewhere in Indonesia. The project continued to work with local partners in the three villages in Pati to conduct the longitudinal ESD household survey, assess the value of different market pathways (especially options for certified timber), evaluate and refine the MTG training courses, pilot the F2FM approach, conduct financial modelling of sengon and teak farm forestry, and a comparative analysis with other land-use options.

Bulukumba – has a fluctuating forest processing sector, creating a dynamic commercial environment for forest products from smallholders. Previous work with smallholders has found them receptive to new silvicultural approaches (FST/2008/030), which has seen smallholders producing higher quality timber and receiving higher prices. The improved timber quality produced by smallholders has enabled some processors to break into the international market for plywood products. While some smallholders have recently

reported receiving higher prices, there are concerns that local farmer groups do not have the business acumen among its members to critically appraise different commercial options for CBCF, leading to farmers having a narrow understanding of the commercial potential of CBCF and being locked into a single market. The project continued to work with local partners in the two villages in Bulukumba to conduct the longitudinal ESD household survey, assess the value of different market pathways, evaluate and refine the MTG training courses, pilot the F2FM approach, and explore the policy context for CBCF.

Gorontalo – has several communities who have recently been granted a commercial lease to participate in the HTR program. However, preliminary analysis by FOERDIA, CIFOR and other partners indicates that the local community is poorly informed about the requirements of the HTR lease (e.g. available funding, interest repayments, forestry options) and the opportunities and risks with commercial forestry. Given the long-term nature of the HTR lease (35 years), and the legally-binding nature for the local community, understanding how to enhance the community's capacity to appraise and implement CBCF (e.g. how does CBCF compare to other feasible land-use options) seems critical. The project team had an existing relationship with the University of Gorontalo (via a CIDA, ICRAF & CIFOR project) and initiated broader collaboration with a range of local partners (e.g. farmer groups, forest agency, NGOs, private sector) for this research. The policy context for the HTR program was analysed in this study site.

Lampung – is one of the few provinces in Indonesia that has established and reputedly successful examples of the HTR program, whereby local communities deeply understand the opportunities and risks of CBCF, and have built their capacity to administer the lease arrangement with the government. Given that the HTR program has achieved less than 15% to date of its national target, the experiences of the HTR program in Lampung appear to be instructive for how it may be implemented elsewhere in Indonesia, including in Gorontalo. The project built on the existing partnerships FOERDIA had with CIFOR and local partners in Lampung responsible for the implementation of the HTR program (e.g. with the University of Lampung). The project conducted an analysis of the relative value of CBCF for smallholders participating in the HTR program, along with an analysis of the policy context in which the HTR program is being implemented.

The project's methodology was not of a classic experimental design with replicated treatments, as the project team was working in a 'real world' context with much of the research conducted in five study sites that were deliberately selected due to obvious differences to each other. The diverse study sites were to cover the widest range of CBCF possible within the scale and scope of the project.

The methodology to underpin each of the project's core objectives is described below.

Objective 1: To enhance the commercial benefits from community-based commercial forestry for smallholders by strengthening their business networks.

Activity 1.1: Conduct a baseline economic and social dimensions study (including the new sites at Lampung and Gorontalo).

The project team conducted a structured household survey in Year 1 (2017) and Year 5 (2020) with the same smallholders sampled in Bulukumba, Gunungkidul and Pati during the previous project (FST/2008/030) in 2013, so as to provide data from three time points (i.e. 2013, 2017 & 2020). Analysis of this time series data aimed to gain a clearer understanding of how smallholders respond to the dynamic opportunities presented by CBCF and likely trends about future resource supplies for industry. The ESD household survey used the same methodology adopted for the Social Dimensions Analysis (FST/2008/030) with a stratified sample of the local communities (30 households selected in 10 villages) with an interest in CBCF on state-owned land at the new sites in Gorontalo and Lampung, with data allowing researchers to compile a comprehensive picture of CBCF across diverse conditions and identify the influential factors driving change among smallholders' livelihoods. The ESD household survey is documented in the project report by Digby Race *et al*. 2021.

Activity 1.2a: Convene workshops with smallholders in each study site (HR and HTR sites) to explore how they can strengthen their links with the relevant private sector partners.

The ESD household survey was a valuable process for enabling participants to identify and discuss viable options for strengthening their links to relevant private sector actors. The preliminary information obtained from the ESD survey relating to pathways to markets was presented and discussed at workshops held at each study location. The workshops enabled the project team to identify the most effective strategy for the project to engage key private sector actors at each location, which in turn was integrated into an overall strategy that was documented in a project report by Aneka Prawesti Suka *et al*. 2021.

Activity 1.2b: Analyse social and economic benefits from enhanced CBCF.

Analysis of the data collected from the baseline household surveys conducted with 300 households across the selected 10 villages, with eight of these villages involved in the previous project (FST/2008/030). The ESD survey largely replicated the survey used by the previous project and involved the same households to enable longitudinal data to be collected and analysed (i.e. data collected in 2013, 2017/18 and 2020), and the contribution by CBCF over time. Households were selected in the previous project to include a representative mix of 'wealth' categories and involvement in CBCF. A sample population in the two new villages was selected using the same process as for the other villages. The ESD survey was approved by Human Research Ethics Committees at the Australian National University (approval 2012/204, for the previous project FST/2008/030) and the University of the Sunshine Coast (approval A/17/979, this project).

Activity 1.3: Analyse the relative value of feasible land-use options for smallholders (e.g. agroforestry, planted forests, NTFPs, cash crops, REDD+) in the study sites, and identify optimum land-use strategies to increase household income.

As the project developed, it became apparent that the most feasible way to explore the comparative value of commercial forestry for smallholders was to undertake two different, yet parallel, analyses – referred to as a 'financial model of sengon and teak' and a 'land-use options' study.

In the 'financial model of sengon and teak', the project team used multiple methods to assemble data for the models. Firstly, we reviewed the literature related to smallholder sengon and teak growing and agroforestry in Indonesia and elsewhere. Secondly, we conducted semi-structured interviews with smallholder growers of sengon and other value chain actors in the Pati district. Thirdly, we collected case study data from smallholder sengon and teak plantations in Pati, including plantation inventory and timber volumes and revenues from a harvesting operation. Fourthly, we set up panels of experts to collate and confirm contemporary field experience on the silvicultural systems and costs for the production of sengon and teak timber by smallholders.

The main methodological framework used to build the models was a financial analysis of direct cash flow impacts of a project (investment in timber production) to an individual or business, following the procedure provided by Herbohn (2002). By applying a discounted cash-flow analysis, the financial parameters calculated as indicators of profitability included net present value (NPV) and internal rate of return (IRR). An investment with a positive NPV provides a profitable management option. IRR represents the maximum interest rate that a project could afford to pay on its funds and still recover all its investment and operating costs or, expressed another way, is the discount rate for which the NPV is zero. As stand-alone investments, all alternatives with an IRR greater than some target rate of return are feasible, with all estimates expressed on a per ha basis. This research is documented in the project report by Hugh Stewart *et al*. 2020.

The approach used for the 'land-use options' study involved collecting data via surveys with smallholders (farmers) in Pati and Bulukumba districts. The selection of this site was based on a database of tree growers who have collaborated with the Trees4Trees foundation, a

non-governmental organization, in a certification program for sustainable community forest management. Sengon and teak plantations of various ages were measured by the farmers in 2015 (so there was some available tree growth data) and 193 farmers working on a project related to 'community timber chain of custody'. The survey was conducted in Pati during 11-15 April 2019. The second site for the 'land-use options' study was in Bulukumba, a district well-known for the Indonesian *phinisi* boat industry that has been operating for several hundred years. However, there is a diminishing supply of timber for this important industry, with timber being supplied from other islands. The survey of smallholders in Bulukumba was conducted during 25-30 April 2019.

The survey respondents in both Pati and Bulukumba districts were randomly selected using 'snow ball' sampling, with smallholders who were available and willing to participate in the survey being selected. The respondents were asked to participate in a face-to-face interview for approximately 60-90 minutes to answer a structured questionnaire. The questions collected data about the respondents' socio-demographic characteristics, land ownership, land use practices, changes that they have made to their land use, and details about their adoption of selected commercial timber trees. The data were descriptively analysed and presented in the project report by Dwiko Permadi *et al*. 2020.

Activity 1.4: Work with private sector and NGO partners interested in forest certification to assess the value of different schemes promoted for CBCF and applicability across different land tenure.

This component of the project aimed to assess the benefits and costs of different forest certification schemes for the private sector and smallholders (in part re-visiting the preliminary research conducted previously by FST/2008/030), with an additional economic analysis of the current and optimum potential for 'certification' to increase returns to smallholders. The method used by the project team was to focus on selected businesses that had invested in 'certification' processes and conduct a range of in-depth interviews and group discussions with staff, smallholders involved in the value-chain as suppliers, and other experienced people working in the private sector and government agencies. This work is documented in two project reports by Dede Rohadi *et al*. 2019 and Tuti Heratwati *et al*. 2019.

Activity 1.5: Prepare succinct guidelines for smallholders that explain the requirements for different forest certification schemes.

The key characteristics and findings from the report documenting the 'Forest Certification Schemes' (Activity 1.4) were translated into a user-friendly booklet for smallholders that explain the requirements for Indonesia's *SVLK* (forest legality certification scheme) – '*Panduan SVLK untuk Petani Hutan Hak*' by Tuti Herawati *et al*. 2018.

Objective 2: To increase the capacity and number of smallholders able to make informed decisions about their silvicultural approach and likely returns from CBCF.

Activity 2.1: Analyse recent experiences of pilot Master TreeGrower (MTG) training courses (conducted under FST/2008/030) to design an effective approach and training materials for CBCF extension.

To achieve this objective, an evaluation of the adoption of knowledge by smallholders involved in the pilot MTG training courses (FST/2008/030) was conducted by Dr Muktasam (University of Mataram) to inform the approach and content developed during this project. The evaluation explored who increased what knowledge and/or adopted new practices as a result of their participation in the MTG training courses, and what implications the adoption of knowledge/practices had for improving CBCF and more generally enhancing rural livelihoods. The evaluation was conducted after the first phase of MTG training courses, so the project team and partners had adequate time to consider the lessons and refine the MTG approach before delivering the second phase of courses by this project. The evaluation method involved analysing an 'exit' survey by participants at the conclusion of each training course, follow-up in-depth interviews and group

discussions, and field inspections of smallholders' farms and forests 12-18 months after they had completed the MTG training. The initial evaluation is documented in the project report by Muktasam *et al*. 2018.

Activity 2.2a: Conduct 15 MTG training courses with FFGs in the study areas (3 MTG courses in each of the five provinces).

The project refined the approach for the MTG training courses and over the five year period, the project team worked with local extension agencies to deliver 15 MTG training courses with FFGs in the study areas. This involved 400+ participants, with MTG courses delivered in all five study locations. A comprehensive evaluation of the whole program of MTG training courses was led by Dr Muktasam and again, involved analysis of an 'exit' survey completed by MTG participants, in-depth interviews and group discussions, and field inspections. This component of the project is documented in the project report by Muktasam, Rowan Reid *et al*. 2021.

Activity 2.2b: MTG manuals

The project team drafted, pre-tested and published a user-friendly 'growers' manual to be given to each participant in the MTG training courses so there was a consistent structure to the topics covered in each course. The project team also prepared a 'facilitator's' manual for staff primarily responsible for providing CBCF advice to smallholders and likely to be lead facilitators of the MTG training courses, so a consistent approach is used for all MTG training courses. The manuals published by the project were led by Dede Rohadi *et al.* 2018 (Facilitator's manual) and Abd. Kadir Wakka *et al.* 2019 (Farmers' manual).

Activity 2.2c: Empowering women involved in CBCF

The previous project found that women are often responsible for selling CBCF products but often miss out on receiving market information and extension support. While the project sought to have women comprise 50% of participants in all MTG courses, in the initial courses the composition was much lower. Analysis by Harsoyo *et al*. (UGM) found several cultural and structural barriers to women's participation in the MTG training courses, as previously delivered. Harsoyo *et al.* designed a participatory approach to work with farming women in the Gunungkidul district over 2-3 years to explore how and why more women might be engaged in the MTG training courses. This work is documented in the project report by Harsoyo *et al*. 2019.

Activity 2.3: Design and implement a pilot of a 'Farmer-to-Farmer Mentoring' (F2FM) program to achieve the effective scaling-out of the CBCF experiences to neighbouring FFGs.

A 'farmer-to-farmer mentoring' (F2FM) pilot was established to explore an innovative approach to scaling-out the CBCF experiences to neighbouring FFGs, an approach that was farmer-led. The project identified a small number of experienced and influential smallholders (about 10 farmers), and who had already completed an MTG training course, from Bulukumba, Gunungkidul and Pati, and their local extension staff, to be trained in how to effectively mentor neighbouring farmers (i.e. listening to farmers concerns, sharing personal experiences). The most effective mentors in the F2FM pilot were smallholders who had developed a high level of confidence in their expertise of CBCF (market knowledge and silviculture) and were willing to share their knowledge with other smallholders. The F2FM pilot was evaluated by Dr Muktasam (University of Mataram, Rural Development specialist), Dr Kadir Wakka (FOERDIA Makassar) and Rowan Reid (Australian Agroforestry Foundation), and is documented in the project report by Muktasam *et al*. 2019.

Objective 3: To analyse the policy context for CBCF and support policy reform that enables it to become a profitable investment choice for smallholders.

Activities 3.1: Conduct a 'foresight' analysis of the major trends occurring in rural Indonesia and their implications for CBCF.

To analyse the major drivers of changes occurring in rural Indonesia now and over the next 20 years (e.g. migration and urbanisation, economic, land-use, policies, trade) and their implications for CBCF, the project conducted a detailed 'foresight' analysis. The methodology for the foresight analysis involved several stages:

- a literature review of publicly available documents (e.g. government forecasts, industry analyses);
- in-depth interviews with a range of experienced stakeholders (n = 26); and
- facilitation of three interactive workshops with 10-15 analysts, policy makers and program managers in each workshop to explore connections and impacts of change in multiple dimensions.

The 'foresight analysis' is documented in the report by Digby Race *et al*. 2021.

3.2: Conduct interactive workshops that translate the 'foresight' analysis into contemporary policy settings (national, provincial & local levels).

As noted above, with one workshop conducted in Jakarta that engaged with national-level policy makers and two workshops conducted in Makassar and Yogyakarta that engaged Provincial and District-level agency staff and analysts. The information from the workshops was integrated into the 'foresight analysis' report, as noted above.

Activity 3.3: Review the factors that influence the success (Lampung) and constraints (Gorontalo) of the government's HTR program that aims to foster CBCF on state-owned land.

This activity was led by Dr Kristiana Wahyudiyati (FOERDIA, Bogor) in its review of factors that affect the success (Lampung) and constraints (Gorontalo) of the HTR program. The project built on an earlier preliminary analysis conducted by FOERDIA, CIFOR, ICRAF and other partners at these two sites to improve understanding on how CBCF can be successfully developed with local communities on state-owned land. The project also identified local factors that affect the implementation of CBCF on state-owned land, seeking insights about the prerequisites for the success of CBCF programs (e.g. the HTR program). This work involved in-depth interviews and group discussions, facilitated workshops and field visits – involving a mix of smallholders, agency staff, NGO program managers and field officers, and private sector staff. This work is documented in the project report by Kristiana Wahyudiyati *et al*. 2019.

Activity 3.4a: Undertake an analysis of policies, programs and regulations that influence the adoption and viability of CBCF, integrating analyses of the government and private sectors, and engaging senior policy makers and program managers.

The policy analysis was led by Dr Lukas Wibowo (FOERDIA, Bogor) and began with a workshop to review recently completed analyses of forestry-related policies, to ensure the project was informed by and built on the latest understanding of the context for CBCF in Indonesia. This project also placed emphasis on incorporating an analysis of the private sector's interest in CBCF, using a staged process: review of policy and company documents; in-depth interviews with selected senior policy makers, program managers and company staff; and the draft report presented and discussed at the 'policy lab' (workshop, see Activity 3.4b below). The policy analysis is documented in the project report by Lukas Wibowo *et al*. 2019.

Activity 3.4b: Conduct 'policy lab' workshops with experienced policy makers and program managers related to CBCF, but not necessarily in the Indonesian Ministry of Environment and Forestry.

The project convened and facilitated an ongoing dialogue with 12-15 of Indonesia's senior policy makers related to CBCF (e.g. program managers of the HTR program), with four 'roundtable' discussions ('policy lab' workshops) held where both policy makers and project researchers gave presentations and shared in the discussion about the policy

context for CBCF, policies challenges and options for reform. The ‘policy lab’ workshops were convened in Jakarta, as a strategy to engage with senior policy makers in the MoEF. A report about the ‘policy lab’ process was prepared by Aneka Prawesti Suka *et al*. 2021.

Activity 3.5: Facilitate a multi-stakeholder discussion forum every 6 months in each study site to exchange CBCF experiences and discuss emerging research findings.

The project team facilitated multi-stakeholder CBCF forums in each of the study sites that were designed to bring together smallholders, private sector entities and government agencies to analyse the local context for CBCF and discuss strategies for supporting and expanding CBCF. The discussion forums were conducted as needed (desired) in each location, with forums held more frequently in some locations (e.g. Bulukumba) than in other locations (e.g. Gorontalo).

6 Achievements against activities and outputs/milestones

Objective 1: To enhance the commercial benefits from CBCF for smallholders by strengthening their business networks.

No.	Activity	Outputs/ milestones	Original completion date	Comments
1.1	Baseline ESD Household survey	ESD survey #2 conducted ESD survey #3 conducted	June 2017 March 2020	ESD survey conducted in 2013 (previous project), 2017 and 2020. **COMPLETED** Analysis completed by December 2020 & reported May 2021. **COMPLETED** (see project report by Digby Race *et al*. 'ESD HH survey' 2021)
1.2a	Private sector stakeholders & links	Analysis of farmers links to private sector & engagement strategy	June 2017	Identify private sector actors most relevant for CBCF in study sites & develop a strategy for engagement. **COMPLETED** (see project report by Aneka Prawesti Suka *et al.* 'Private sector links' 2020)
1.2b	Social & business network analysis	Analyse farmers' networks from ESD data to be documented in *'Report on achievements in reconfiguring social networks of disadvantaged smallholders'*	June 2017	Analysis of farmers' social & business networks reported with ESD results (see activity 1.1 above). Report finalised by May 2021. **COMPLETED** (incorporated into project report by Digby Race *et al*. 'ESD HH survey' 2021, see above)
1.3	Land-use options analysis	Analysis of smallholder land-use options in Pati & Bulukumba	Dec. 2016	Methodology designed & field tested in mid-2018, with assessment completed by late-2019 for review. Report finalised by July 2020. Financial analysis of sengon & teak growing in Pati. **COMPLETED** (see project report by Hugh Stewart *et al.* 'Financial models' 2020). Land-use options study in Bulukumba & Pati. **COMPLETED** (see project report by Dwiko Permadi *et al*. 'Land-use options' 2020)
1.4	Forest certification analysis	Analysis of forest certification for smallholders	Dec. 2016	Forest certification study completed & report finalised March 2020. **COMPLETED** (see project reports by Dede Rohadi *et al.* 'Timber certification' 2019 and Tuti Herawati *et al*. 'Smallholder timber certification' 2019)
1.5	Forest certification guidelines	Guidelines published & shared	June 2018	SVLK guidelines prepared & published in April 2018. **COMPLETED** (see publication by Tuti Herawati *et al*. 2018)

Economic and Social Dimensions Household survey

The Economic and Social Dimensions (ESD) Household survey (activity 1.1) employed by this project was informed by other household surveys designed to capture livelihood data (Grosh and Glewwe 2000, Fisher *et al.* 2010, FAO *et al.* 2018). The ESD survey was designed to explore the contribution of smallholder forestry to rural livelihoods in Indonesia. The ESD survey collected data from a diverse sample of families in 10 villages (five provinces) in Indonesia, with data collected from mainly the same households in 2013, 2017 and 2020 (80% of originally sampled households were re-surveyed). The ESD survey was designed with locally-constructed 'wealth' indicators (e.g. land ownership, annual cash income, construction material of house, number and type of vehicles, livestock number and type) and topics relevant to smallholder forestry, and completed with a purposeful sample of households that reflected the wider distribution of households across the village's 'wealth' categories. A household survey was viewed by the research team as an effective tool to collect comparable data by different members of the research team in multiple locations.

Despite the deliberate and intensive nature of the ESD survey design and implementation, the project team recognise the limitations in the methodology. Some of the lessons from other rural livelihood surveys include: household heads (often men) can have a poor understanding of a household's economy (Fisher *et al.* 2010), different enumerators involved in lengthy multi-topic surveys can lead to inconsistent data (Grosh and Glewwe 2000), and the seasonal variation of activities and yields by rural households means data can be misleading if extrapolated across the whole year, or across several years (FAO *et al.* 2018). These limitations are particularly relevant for this ESD survey as certain forestry activities can be highly gendered (e.g. harvesting timber for commercial markets most commonly negotiated by men), a large majority of surveys were completed by male household heads, and some forest products (particularly high-value timber) are harvested infrequently. Another challenge for household surveys is to aggregate data and scale-up the interpretation of the results at a national level, particularly in a country that is as economically, socially and geographically diverse as Indonesia.

The ESD survey was employed in farming communities where 'social forestry' is considered by the government as a viable option, with the study site locations described in more detail above in Section 5 Methodology. Much of the ESD survey was designed, pre-tested and implemented in 2013 as part of a past research project involving the authors (FST/2008/030). We built on this and expanded the survey in 2017 to explore the business links and trade behaviour of smallholders involved in forestry, as a means to understand local supply chains that underpin smallholder forestry (Irawanti *et al.* 2017).

The ESD survey was initially conducted in three districts in Indonesia where the project team and research colleagues have established long-term relationships with the local communities in the districts of Bulukumba (South Sulawesi province), Gunungkidul (Special Region of Yogyakarta) and Pati (Central Java). The Indonesia government's Ministry of Environment and Forestry (MoEF) seeks to have community-based commercial forestry more widely established, with a target of nearly 400,000 ha of 'social forestry' to be established by 2019 in the three provinces where the ESD survey was conducted (MoEF 2018, p.84), yet just 15% of the target in the three provinces had been achieved by September 2018. The results of the project's ESD survey were anticipated to inform the understanding of why the MoEF's policy goals for CBCF have not achieved.

Repeating the ESD survey in 2017 and 2020 with a relatively consistent sample population provided the opportunity to explore any changes over a multi-year period. Two new study areas were included in the project's geographical scope – Boalemo (Gorontalo) and South Lampung (Lampung), with the ESD survey employed in a similar way in two new study areas in 2018 and 2020.

The ESD survey was conducted with a stratified sample of 30 households per village, across ten villages in five provinces (N=300). All households in the selected villages were identified that belonged to one of three wealth categories (i.e. 'low', 'medium' and 'high' wealth), using a locally derived wealth index. The project team convened a group of

smallholders to identify indicators that reflected different levels of wealth for their village (as discussed above), and then nominated each household into one of the three categories. The sample households in each village reflected the same proportion of households in the three wealth categories (i.e. stratified based on perceived wealth), then individual households were randomly selected within each wealth category. The wealth category that each household belonged to is thought to have a strong influence on the type and scale of forestry that smallholders may be involved in. For example, 'low' wealth households were anticipated to be most interested in short-rotation forest enterprises, even if representing lower commercial value over the long-term, compared to 'high' wealth households which may be more willing to forgo short-term income for larger returns in the long-term (e.g. high-quality, large diameter timber production).

The survey was pre-tested and refined, with completion of the survey typically taking one to two hours per household facilitated by a member of the research team and a field assistant. All the discussion with respondents of surveys was conducted in *bahasa Indonesia*. While some survey respondents did not use this as their primary language, they were assessed by the field researcher as being sufficiently fluent for the purpose of understanding and completing the survey. The completion of 30 surveys per village often took about three to four days, with two or three pairs of researchers working concurrently. Data compilation involved different members of the research team managing data entry and preliminary analysis for ESD surveys completed in the villages under their responsibility. Two face-to-face meetings among the project team were held to harmonise the data entry and interpretation.

Overview of sample population for ESD household survey

A high proportion of survey respondents who participated in the first ESD survey which was conducted in 2013 were re-surveyed in 2017 (85%) and again in 2020 (overall 80%, *n* = 204), with an additional sample in 2018 and 2020 (*n* = 60) in the new study areas (Table 1, below). The high proportion of households re-surveyed provides a strong basis for tracking changes over time (i.e. differences between 2013, 2017 and 2020). The majority of the respondents were from 'medium' (52%) or 'low' (35%) wealth households, with 'high' wealth households comprising 13% of the sample. As discussed above, the sample population in each study village was designed to reflect the relative wealth of households in the wider village population. In Boalemo and South Lampung, 97% of households involved in the ESD survey in 2018 were re-surveyed in 2020. The 'ESD household survey' component of this project is fully described in the project report by Digby Race *et al.* 2021.

Table 1: Overview of sample population for household survey

Village	District	'low' wealth (%)	'medium' wealth (%)	'high' wealth (%)	Farm area 2013 (ha)	Farm area 2017/18 (ha)	Farm area 2020 (ha)
Benjala	Bulukumba	27	67	7	1.11	0.74	0.94
Malleleng	Bulukumba	23	47	30	1.45	1.56	1.57
Dengok	Gunungkidul	33	54	13	1.19	0.94	0.86
Jepitu	Gunungkidul	10	77	13	1.30	2.07	1.55
Katongan	Gunungkidul	33	57	10	0.55	0.46	0.71
Giling	Pati	41	41	18	0.83	0.10	0.89
Gunungsari	Pati	47	43	10	1.04	1.26	0.62
Payak	Pati	70	27	3	1.98	0.85	0.36
Average		35%	52%	13%	1.18	1.11	0.94
Rumbia	Boalemo	70	27	3	-	8.00	8.49
Budi Lestari	Sth Lamp.	47	53	0	-	1.21	1.15
Average		58%	40%	2%	-	4.60	4.82

Source: Authors' primary data 2013, 2017/18 & 2020.

Private sector engagement

The project explored ways to strengthen engagement with private sector actors relevant to smallholder forestry in the five study areas (activity 1.2a). The districts of Bulukumba, Gunungkidul and Pati are areas where smallholders commonly manage forests on private farmland, while Boalemo and South Lampung are areas where smallholders are developing commercial forestry enterprises on state-owned leasehold land, supported through the Community Forest Plantation (HTR) scheme. These study locations offer a wide range of environmental and market conditions, different development stages, and a variety of private sector actors relevant to CBCF (each study site location is described in more detail above in Section 5 Methodology).

This component of the project was achieved by undertaking data collection during May-December 2018 using semi-structured interviews of experienced staff from business entities (individuals and company staff) along the dominant timber value chain in each study location. The sampling method applied was the 'snowball' technique. This involved interviewing an initial set of research participants who provided information about the research topics and other potential participants (Given, 2008). The initial set of research participants were the first level business entities – traders (i.e. market brokers) to whom farmers sold their timber, identified from the results of the ESD survey in each study location. Respondents were then selected following the dominant value chain in each study location. There were 22 interviewees (20 men and 2 women) for this study, selected from across the five study locations. Table 2 provides details of the study respondents.

Table 2: Private sector interviewees

Categories	Private sector type	Number of respondents
Timber trade	Farmer	1*
	Trader	7
Primary industry	Timber depot	2
	Sawmill	5
Manufacturing industry	*Phinisi* (boat)	2
	Furniture	2
	Plywood	3

Note: * Located in Boalemo, where sometimes farmers sold timber in the form of building materials as directly requested by buyers.

The information explored during the interviews was:

- Who the respondent trades with along the value chain?
- What information do they need to better conduct their work?
- Are they interested in some components of the project?
- How can the project assist them?
- Other information/issues?

Stakeholder analysis was applied to analyse the data obtained from the interviews in order to explore the interests of the key actors in the timber value chain and develop an engagement strategy. The stakeholder analysis began by defining the actors involved. Given the aim of the study, which was to engage with the private sector actors that play dominant roles in CBCF in each study location, the timber value chain in each study location needed to be defined. Actors along the chain then became the research respondents (as individuals or company staff). The actors identified were mostly farmers, traders and processors along the timber value chain in each study location. A unique situation was found in Boalemo, where the short value chains and final consumers were directly involved in the value chain, meaning it was easier to identify and engage the different actors in the project activities. The 'private sector engagement' component of this project is fully described in the project report by Aneka Prawesti Suka *et al.* 2020.

Financial model of sengon and teak

The project team used multiple methods to assemble data for the financial models of growing sengon and teak by smallholders (activity 1.3). Firstly, we reviewed the literature related to smallholder teak and sengon growing and agroforestry in Indonesia and elsewhere. Secondly, we conducted semi-structured interviews with smallholder growers of sengon and other value chain actors in the Pati district. Thirdly, we collected case study data from smallholder sengon and teak plantations in the Gunungwungkal subdistrict in Pati, including plantation inventory and timber volumes and revenues from a harvesting operation. Fourthly, we set up panels of experts to collate and confirm contemporary field experience on the silvicultural systems and costs for the production of sengon and teak timber by smallholders.

The main methodological framework used to build the models was a financial analysis of direct cash flow impacts of a project (investment in timber production) to an individual or business, following the procedure provided by Herbohn (2002). By applying a discounted cash-flow analysis, the financial parameters calculated as indicators of profitability included net present value (NPV) and internal rate of return (IRR). An investment with a positive NPV provides a profitable management option. IRR represents the maximum interest rate that a project could afford to pay on its funds and still recover all its investment and operating costs or, expressed another way, is the discount rate for which the NPV is zero. As stand-alone investments, all alternatives with an IRR greater than some target rate of return are feasible. All estimates were expressed on a per ha basis.

Smallholder growers of sengon and other value chain actors were interviewed in the Pati district. To identify value chain actors, we used informal networks among actors. The semi-structured interviews were conducted from May to August 2018 by field staff of Trees4Trees. Ten smallholder growers of sengon in the district of Pati were interviewed. Other actors interviewed were a log buyer, and a harvest and transport operator, who were dealing in smallholder logs from the subdistrict of Gunungwungkal. Three processors of smallholder logs were interviewed: CV. Kembang Sengon in Pati; Eurasia Woodwork in Semarang (processor of teak); and PT. ABP in Semarang (processor of sengon).

Trees4Trees established a series of permanent sample plots (each 0.08 ha) in smallholder plantations of sengon, teak and mixed species across a range of age classes in the Gunungwungkal and Tlogowungu subdistricts in the Pati district. In September 2015 they conducted inventory by measuring diameters at 1.3 m above ground and heights of all trees on each plot. We analysed the data for the plots in sengon plantations that were 5-6 years of age, and teak plantations that were 12 years of age (the oldest age class

measured). For sengon we used the measurements of diameter to estimate individual tree volume using the volume table for that species provided by Rohadi *et al*. (2018). We estimated total volume per plot and calculated mean annual increment of the plantations. For teak we used the measurements of diameter and height and a form factor of 0.432 (Pachas *et al.* 2019a) to estimate individual tree volumes.

An expert panel met at Semarang on 26 July 2018, to provide advice on a silvicultural regime for sengon applicable to smallholder growers. The panel comprised: Dr Hugh Stewart (Convenor), University of the Sunshine Coast; Devi Silvia, Trees4Trees; Achmad Darisman, Trees4Trees; Dr Dede Rohadi, Centre for International Forestry Research; Dr Tuti Herawati, Centre for International Forestry Research; and Dr Dwiko Permadi, University of Gadjah Mada. The panel members brought research, technical and practical experience related to sengon growing by smallholders in Indonesia.

Another expert panel met at Semarang on 2-3 September 2019, to provide advice on field practices (e.g. pruning), material costs and labour for the establishment and management of sengon and teak plantations, and harvest and transport costs. The panel comprised: Dr Hugh Stewart (Convenor), University of the Sunshine Coast and from Trees4Trees: Devi Silvia, Achmad Darisman, D. Mark Schmidt, Dani and Novita Arianti. The panel members brought both research and practical experience related to sengon and teak cultivation by smallholders in the Pati district.

Expert advice on the silviculture of teak grown by smallholders was also provided by Dr Dede Rohadi, Centre for International Forestry Research; and by Dr Eko Bhakti Hardiyanto, Faculty of Forestry, University of Gadjah Mada. Both have studied and published on the subject over the last two decades.

Silvicultural system

We developed a silvicultural system for sengon grown by smallholders in the Gunungwungkul subdistrict using the following sources of information: 1) expert panel; 2) responses from semi-structured interviews with smallholder growers of sengon in Pati; 3) inventory and market information collected during the sengon case study; and 4) growth and yield, and silvicultural information in the literature (e.g. Krisnawati *et al*. 2011, Rohadi *et al*. 2018).

The main features of the silvicultural system were a medium-density initial stocking, form pruning or 'singling', two commercial thinnings and a rotation age of 6 years. Seedling trees were planted at a spacing of 2 m x 3 m, providing an initial stocking of 1667 trees ha^{-1}. Smallholders who grow sengon commonly use a mixture of manure and inorganic fertilisers (e.g. as observed in the case study). Each seedling was fertilised at planting with 5 kg of manure and 100 g of NPK fertiliser [14: 14: 14] (Krisnawati *et al*. 2011). Regarding initial stocking and rotation length, in East Java, Perum Perhutani manage most sengon industrial plantations on an 8-year rotation with a 2 m x 3 m initial spacing (Kurinobu *et al*. 2007).

We assumed that after six months 85% of trees had survived and had the potential to produce merchantable logs at rotation age. Sengon has a tendency to fork, so form pruning at an early age is recommended to produce single boles (Krisnawati *et al*. 2011). We scheduled form pruning at six months after planting.

During our research we were unable to locate any contemporary yield tables for sengon[1] – that is, projections of the amount of merchantable wood available per unit area from a stand of trees at a given age for a given site quality, together with estimates of the amounts of logs available in different log size classes. Our approach was to estimate the

[1] *Krisnawati et al. (2011, Fig. 14) presented volume increment against age by site quality for sengon plantations redrawn from preliminary yield tables prepared by another researcher in 1961.*

standing volumes and volumes harvested at the first and second thinnings and at rotation age by calculating at each time the volume of the tree of average diameter and multiplying it by the number of trees harvested or retained. We considered two options – to use the individual tree volume table for sengon (Rohadi *et al*. 2018), or to use stem volume equations that estimate the volumes of individual trees from the input variable of diameter. Some equations for sengon were provided in Krisnawati *et al*. (2011). We compared the output of one of those equations (log V = – 3.590 + 2.3528*log D, where V (m^3) is underbark stem volume to a 5 cm upper diameter and D (cm) is tree diameter measured 1.3 m above ground) against the output of the volume table provided by Rohadi *et al*. (2018, Table 6 – see Annex 2). For tree diameters of 10 cm to 30 cm in 5 cm intervals, we found that the equation estimated 33-35% more volume than the volume table. We chose to use the volume table for two reasons. First, it was developed specifically for smallholder sengon production in the Gunungwungkal subdistrict whereas the equation was developed from sample trees in West Java; and second, we were of the opinion that the volume table was likely to be a better predictor of merchantable tree volume than the equation. At age 2 years we estimated that average tree diameter was 8 cm. The minimum tree diameter in the volume table is 10 cm, so we inferred volume of a tree of 8 cm diameter as 0.023 m^3.[2]

To estimate the log volumes by size class at the final harvest – when most of the revenue is generated – we prepared estimates of the amounts of logs available in different log size classes, drawing on the results of the sengon case study. All harvest volumes were rounded to the nearest whole number. We assumed that the modelled stand would have a diameter distribution closer to a normal distribution than the stand assessed in the case study.

Development of the financial model

For simplicity, no tax (e.g. deductions related to cash outflows, income tax) was factored into the analysis. Financial analysis was conducted with the year 2020 as the base year using the computer spreadsheet package Excel and its inbuilt functions for calculating such parameters as NPV and IRR. The NPV calculation is for cashflows at the end of each period equally spaced in time (e.g. year), that is, future cashflows; if the first cash flow (i.e. initial expenditure) occurs at the beginning of the first period, the first value must be added to the NPV result, not included in the value 'arguments' of the function (Herbohn and Harrison 2002). We followed this method.

The discount rate is the cost of financial capital required for the investment. At a known discount rate, NPV and land expectation value (equivalent to the NPV over perpetuity) are the theoretically best criteria for ranking alternative forestry investments. Given the difficulty in identifying an appropriate discount rate, many analysts use the IRR as a ranking criterion if discount rates are variable or not specifically set by corporate or government policy (Cubbage *et al*. 2007).

Costs and benefits measured in real terms (that is, they don't contain the effects of any expected inflation) should be discounted with a real discount rate. If costs and benefits are measured in nominal (or current) dollars, they should be discounted with a nominal discount rate. Both approaches should result in the same NPV (Harrison 2010).

A range of discount rates have been used in analyses of forestry and agroforestry investments. They include 8% as a common rate used by forestry companies (Cubbage *et al*. 2007); 5% real for farm forestry in Australia (Stewart *et al*. 2011); 10% nominal ('nominal' being a discount rate that incorporates the expected inflation rate) for analysing investments by smallholders in balsa plantations in Papua New Guinea (Midgley *et al*. 2010); 12% nominal for smallholder teak plantations in Sulawesi (Midgley *et al*. 2007);

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[2] *Volume calculated as: V (m^3) = $\pi * D^2/4 * H * FF$, where D = diameter (cm), H = height (m, calculated from Krisnawati et al. (2011)) and FF = form factor of 0.4.*

17.5% nominal for community forest plantations of sengon in East Java based on the nominal investment rate for 2002 as reported by the Bank of Indonesia (Siregar *et al*. 2007); and 10% for analysing the economics of agroforestry systems in Indonesia, selected to match the banking system of the research sites (Herawati 2013, Rahman *et al*. 2019).

Drawing on these studies we chose a real discount rate of 8%. Using this approach, we expressed all variables in terms of the price level for a given year, normally taken as the present year (Harrison 2010). Thus, constant prices estimated for year 2020 were used for all inputs and outputs. We noted that market interest rates – the prevailing rates of interest offered on cash deposits, and usually the nominal rates (Harrison 2010) – in Indonesia are about 5%[3] and the inflation rate in Indonesia the past 2 years has been about 3%[4]. We also noted the view of Cubbage *et al*. (2007) that long-term real rates of return are probably only 4% to 8% for most forestry investments, despite higher corporate hurdle rates.

Sensitivity analysis

Appropriate adjustments for such factors as taxes and risk cannot be precisely estimated, which is one reason why sensitivity testing is important (Harrison 2010). For this reason, Harrison suggested a base real discount rate of 8%, and testing over a range of 3% to 10%. The tree growing investments studied differed greatly in their rotation length (sengon 6 years; teak 20 years). To provide a truer comparison of the economic benefits of each investment we estimated the land expectation value (LEV) – the NPV for an infinite sequence of identical rotations – which is useful to compare forestry investments of unequal duration (Herbohn 2002). In this analysis the NPV is treated as a constant periodic income that is received each rotation. LEV in effect calculates the value of bare land under permanent timber production. The LEV will be much higher than the NPV for short rotations, but for long rotations the LEV will differ little from the NPV (Herbohn 2002). We also tested the sensitivity of this result to discount rates of 4% and 12%. Across this range of discount rates, we calculated the benefit–cost ratio as the quotient of the present value of revenue and the present value of costs. The result should be greater than one in order for a project to be considered acceptable.

We also calculated annual equivalent return (AER) as the annualised NPV over perpetuity (Polglase *et al*. 2008). This provides a metric to allow comparisons of the returns from longer term forestry investments with investments that generate annual incomes, such as annual crops or other agricultural enterprises (Cubbage *et al*. 2007, Polglase *et al*. 2008). Expressed another way, the AER is an annuity where the net present value is distributed equally across perpetuity. We also used the AER as an indicator of the break-even annual land rental, or the maximum annual rent that could be paid, for growing sengon on a 6-year rotation. During our research we attempted to collect data on the value of, and the cost to rent, agricultural land owned by smallholders, but we found it difficult to obtain reliable estimates. Krishna *et al*. (2017) observed that land markets in Indonesia are largely informal, with land transactions often lacking proper documentation and registration, making it difficult to generate data on land sales. Most land market transactions involve signing a civil agreement of ownership transfer with village officials as key witnesses; this can occur with or without formal land titles.

During the research we were able to collect data on the costs of pruning to improve log quality yet were unable to discover price differentials for pruned and unpruned logs. We hypothesised that pruning is a profitable investment on the basis that it produces knot-free timber for specific end-uses, which should command a higher market value compared to

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[3] *https://indonesia.financialadvisory.com/time-deposits.html.*

[4] *https://www.bi.go.id/en/moneter/inflasi/data/Default.aspx.*

unpruned logs. We therefore undertook an analysis to calculate the increase in log revenue at the final harvest that would be required to break even with the cost of pruning.

We also calculated the return to labour – the labour cost at which the NPV is zero – which is a useful metric for family farms where labour is the primary asset, and where there are alternative external employment options (Khasanah *et al*. 2015). The 'financial model of sengon and teak' component of this project is documented in the project report by Hugh Stewart *et al.* 2020.

Land-use options study

The 'land-use options' study was designed to explore the potential crop options available for smallholders in the districts of Pati and Bulukumba, and the extent smallholders would select commercial forestry as a land-use (activity 1.3). The data collection involved surveys of smallholders (farmers) in both Pati and Bulukumba districts. Pati is located about 2 hours by car from Semarang, the capital city of Central Java. The selection of this site was based on a database of tree growers who have collaborated with Trees4Trees foundation (an NGO based in Semarang[5]), in a certification program for sustainable community forest management. At those locations, sengon and teak plantations of various ages were measured by the farmers in 2015. In that year, the number of farmers participating in the forestry partnership with the Trees4Trees foundation and working in the community timber chain of custody activities was 193. The survey in this district was conducted during the 11-15 April 2019 with smallholders in the sub-districts of Gunungwungkal, Kayen and Tambakromo. In this study, 42 of the participating farmers (21.8%) were selected as respondents. About 26% of the respondents had established both sengon and teak plantations, while 42.9% and 30.9% had established only sengon or teak, respectively.

The second location for this study was Bulukumba, located approximately 164-180 km from Makassar and can be reached within 4–5 hours by car. Bulukumba is well-known as the origin of Indonesia's *phinisi* boat industry that has operated for many hundreds of years. However, there is a diminishing supply of timber nearby for this important industry. The survey of smallholders in Bulukumba was conducted during the 25-30 April 2019.

The survey respondents in Pati and Bulukumba were randomly selected using 'accidental' sampling. Smallholder farmers that were easily located and were willing to be interviewed in the field at the time of the study were selected to participate. The respondents were asked to participate in a face-to-face interview for approximately 60-90 minutes to answer a structured questionnaire. The questions collected information about the respondents' socio-demographic characteristics, land ownership, land-use practices, changes that they have made to their land-use, and details about their adoption of selected commercial timber trees. The 'land-use study' component of this project is documented in the project report by Dwiko Permadi *et al.* 2020.

Forest certification

Forests have been certified since the early 1990s under a number of schemes to address the issues of global deforestation and forest degradation, and to promote responsible forest management. Certification schemes have a set of principles, criteria and indicators related to the ecological, social and economic aspects of forest management. Independent bodies assess the compliance of forest management against the schemes (Romero *et al*. 2013). Forest certification of smallholder and community forestry in Indonesia operates under three schemes:

- Forest Stewardship Council (FSC) scheme, a global scheme that is voluntary;

[5] https://trees4trees.org/

- Indonesian Ecolabelling Institute (LEI, *Lembaga Ekolabel Indonesia*) scheme that is voluntary; and
- Indonesian Timber Legality Assurance System (SVLK, *Sistem Verifikasi Legalitas Kayu*) that is required by Indonesian law for all wood product exporters from Indonesia.

The two main schemes are FSC and SVLK. The project team compiled an overview of these two schemes in Indonesia with particular reference to smallholder and community forests, and progress of certification as measured by the number of certificates issued and the area of forest certified (activity 1.4). The 'forest certification' component of this project is documented in the project reports by Dede Rohadi *et al*. 2019 and Tuti Herawati *et al.* 2019.

Objective 2: To increase the capacity & number of smallholders able to make informed decisions about their silvicultural approach & likely returns from CBCF.

No.	Activity	Outputs/ milestones	Original completion date	Comments
2.1	Evaluate pilot MTG	Report on evaluation of MTG pilot courses	June 2017	Comprehensive evaluation of MTG pilot courses conducted by mid-2017. Report finalised March 2018. **COMPLETED** (see report by Muktasam *et al*. 'MTG Indonesia pilot evaluation' 2017)
2.2a	Refine MTG & implement	Refine approach & deliver 5 MTG courses by mid-2018 & a total of 15 MTG courses by mid-2020.	June 2018	Based on key findings & lessons from the evaluation (2.1), the approach & content of MTG training courses were refined in early-2018, with 15 MTG courses delivered by end-2020. Report finalised by May 2021. **COMPLETED** (see project report by Muktasam, Rowan Reid *et al*. 'MTG Indonesia evaluation' 2021)
2.2b	Design MTG manuals	Design & draft MTG manuals	June 2017	The MTG Farmers' manual was published in Sept. 2017 & the MTG Trainers' manual finalised in Apr. 2018. Revised MTG Farmers' manual published December 2019. **COMPLETED** (see publications by Abd. Kadir Wakka *et al*. 'MTG Farmers' manual' 2017 and Dede Rohadi *et al*. 'MTG Facilitators' manual' 2018)
2.2c	Empower women in CBCF	Design a feasible empowerment strategy	March 2020	A strategy to engage rural women more actively in CBCF was developed in Gunungkidul by early-2018. The approach was trialled, evaluated & reported by March 2020. **COMPLETED** (see project report by Harsoyo *et al.* 'Empowering women in CBCF' 2020)
2.3	Design farmer-to-farmer mentoring	Design & deliver a pilot approach to F2FM	June 2018	The concept of F2FM was initiated & a pilot conducted during Jul-Dec 2018, and evaluated & reported by March 2020. **COMPLETED** (see project report by Muktasam *et al.* 'F2FM trial' 2020)

Master TreeGrower training courses

During the precursor project (FST/2008/030), the Master TreeGrower (MTG) training course was adapted and trialled during 2014 in five study sites in Indonesia: Sumbawa (West Nusa Tenggara), Pati (Central Java), Gunungkidul (Yogyakarta), Bulukumba (South Sulawesi), and Konawe (Southeast Sulawesi). Both an initial (2014) and subsequent evaluation (2017) (activity 2.1) of these training courses indicated that the MTG courses were effective in promoting tree growers' learning on markets, farm and tree management, measurement, and other topics (Reid and Syafii, *et al*., 2014; Muktasam and Reid, 2017). The evaluations also found that the MTG courses had encouraged many landholders to change their silvicultural practices and marketing practices. The evaluations also reported several suggestions on how the MTG training courses could be improved during this project (FST/2015/040).

As result, a re-designed MTG course content and delivery model was suggested and implemented in the 15 MTG courses delivered in this project. The main objectives of the evaluation of the re-designed MTG training courses were to:

- evaluate the effectiveness of the MTG re-design courses in promoting smallholders' learning of various aspects of community-based commercial forestry such as timber marketing, measurement, tree and farm management, risk management, and any locally specific content included in the MTG courses (such as pest and disease management);
- get some input and suggestions that may contribute to the refinement of the MTG model to better meet the local and specific needs of Indonesian smallholder timber growers and CBCF stakeholders; and
- produce more effective MTG course manuals for both farmers and trainers/facilitators specifically suited to the Indonesian context.

The main input to the re-design of the MTG training course (activity 2.2a) was the result of previous MTG evaluation activities (Muktasam and Reid, 2017). A draft of the MTG re-design was developed and then shared with the project team. The feedback from the meetings was used to improve the MTG re-design draft which was then shared with the wider project team. Again, the MTG training courses were evaluated, primarily by:

- a written survey completed by all participants on the last day of the training; and
- an *ex-post* evaluation or practice evaluation to assess changes in participants' farm management practices such as in marketing, measurement, and tree and farm management a few months after the courses, assessed focus group discussions, in-depth interviews and field observations.

The results of both these evaluations are presented in the reports by Muktasam *et al*. 2017 and 2021.

Empowering women in CBCF via MTG training

The project team developed a different strategy designed to encourage greater participation by women in the MTG training courses (activity 2.2c). This strategy included a respected local woman in the promotion of the training course to other villages and including her in the discussions about the course design. Field-based experience showed that focus group discussions (FGDs) with women as prospective training participants, conducted before the training, can inform the organisers about the most appropriate design for training and significantly increase the number of women participants, such as by identifying the aspirations, needs, constraints and daily tasks of female farmers. The FGDs gave a much stronger understanding of the nature of the 'double burden' faced by most farming women.

The information obtained via the FGDs enabled the project team's MTG trainers to design a gender-responsive approach to training women farmers. The new approach for the MTG training when re-designed to better suit women interested in forestry included:

- commencing after 9 am (after many domestic tasks had been completed) and concluding by 3 pm; and
- conducting the training close to the participants' homes (to reduce travel time).

By applying these two adaptations to the MTG training course, the number of women participating in forestry training increased significantly and the knowledge of women after training also increased. By altering the MTG course structure to adapt to the local women's needs, more women were able to participate. In other words, increasing the participation of women in the MTG training courses can be achieved by relatively simple adjustments to the structure of the course and its delivery location (i.e. timing the training to better align with most women's other commitments) and this led to a considerable increase in attendance by women, with the proportion of women participating in the MTG courses being 50% at Katongan village, 67% at Jepitu village and 73% at Dengok village (Table 3). This component of the project – 'enhancing women in MTG training' is documented in the project report by Harsoyo *et al*. 2020.

Table 3: Details of the MTG training conducted in Gunungkidul in 2018-19

MTG Course sites	Date	Number of Participants	
		Male	Female
Jepitu Village	3, 10, 17 & 18 March 2018;	6 (33%)	12 (67%)
Katongan Village	20-21 October & 27-28 October 2018	10 (50%)	10 (50%)
Dengok Village	24- 25 November & 1- 2 December 2018	4 (27%)	11 (73%)
Wanagama Educational Forest	3, 9, 17 & 18 November 2019	32 (71%)	13 (29%)
	TOTAL	52 (53%)	46 (47%)

Farmer-to-Farmer Mentoring

The project team recognised that many of the MTG participants were keen to share their knowledge with other farmers, so a Farmer-to-Farmer Mentoring (F2FM) model was introduced and trialled as a possible means of scaling-out the impacts of MTG training courses (activity 2.3). A training workshop among potential mentors from Bulukumba, Pati and Gunungkidul was conducted in Semarang and Ungaran on the 26-29 July 2018. The F2FM Training Workshop produced a Mentoring Action Plan to support the participants' mentoring other farmers.

The Mentoring Action Plan was used to monitor the progress and to evaluate the effectiveness of the F2FM. Monitoring data collected from August 2018 to February 2019, and the final evaluation conducted in February to April 2019 confirmed that the approach of F2FM has the potential to promote positive changes in the surrounding farmers. The F2FM pilot program was judged to have been very successful in Bulukumba while a lower performance was recorded in Gunungkidul and Pati. The 'F2FM trial' component of this project is documented in the report by Muktasam *et al*. 2020.

Objective 3: To analyse the policy context for CBCF & support policy reform that enables it to become a profitable investment choice for smallholders.

No.	Activity	Outputs/ milestones	Original completion date	Comments
3.1	Foresight analysis	Design foresight method	June 2017	Approach to foresight analysis designed & literature review completed Sept. 2017. Interviews conducted, analysed & reported by August 2019. **COMPLETED** (incorporated into project report noted below)
3.2	Foresight workshops	Conduct foresight workshops & finalise report	April 2021	Three workshops to be held by October 2020 & report finalised by May 2021. **COMPLETED** (see project report by Digby Race *et al*. 'Foresight analysis' 2021)
3.3	Review of HTR	Analysis of HTR program	June 2018	Analysis of HTR program by end-2017, and expanded & finalised by early-2019, with policy brief by end-2019. **COMPLETED** (see project report by Kristiana Tri Wahyudiyati *et al*. 'HTR analysis' 2017)
3.4a	Review of policy context	Analysis of policy context	June 2017	Analysis of policy context for CBCF by mid-2018, and report finalised by early-2019, with policy brief by end-2019. **COMPLETED** (see project report by Lukas Rumboko Wibowo *et al*. 'CBCF Policy' 2019)
3.4b	Policy labs	Design & convene 'policy labs' with diverse range of policy makers	June 2017	Design an effective 'policy lab' approach & convened 1st workshop in Jan. 2017, 2nd workshop in May 2018, 3rd workshop in Oct 2020 & 4th workshop in Feb 2021. Report on 'policy labs' finalised by May 2021. **COMPLETED** (see project report by Aneka Prawesti Suka *et al*. 'Policy labs' 2021)
3.5	Discussion forums at 5 study sites	Design & conduct CBCF discussion forums	June 2021	Design & conduct CBCF discussion forums with local stakeholders at each study site on 6-monthly basis. The project newsletters were published & distributed at the discussion forums held at each study site (every 6 months, bi-lingual). **COMPLETED** (see project report by Aneka Prawesti Suka *et al*. 'Communication summary' 2021 and project's newsletters x 9).

Foresight analysis

Indonesia's economy is dynamic and expanding, but like any other country, it is not isolated from global economic shocks and challenges (e.g. the global recession in 2020 caused by the covid-19 pandemic). Looking ahead to what the context might be like for smallholder forestry, say in 2030, was an important activity undertaken by the project team (activities 3.1 & 3.2). Investment in forestry is invariably long-term, particularly compared to many agricultural crops, so careful thought is required by smallholders, governments and processors to ensure their investment is likely to be successful.

The foresight process initially involved a review of literature to identify potential major influences on smallholder forestry in Indonesia in 2030, and identify key influences and

markets for smallholders (Robins & Kanowski 2019). Literature invariably tends to be more generic and provide insights at a coarse scale, so it is difficult to reflect the detailed constraints and opportunities in a country so diverse such as Indonesia. The literature review identified that Indonesia's economy is anticipated to grow, leading to an expanding middle class with increasing incomes. This in turn will drive consumption and the demand for niche markets of high quality forest products (e.g. appearance grade timber, NTFPs). However, the challenge for smallholders will remain as to whether they can grow forest products of adequate quality and on a sufficient scale for CBCF to be a profitable enterprise. Smallholders in proximity to large regional and capital cities appear most likely to respond to the signals of niche markets.

Then the foresight process interviewed 26 people with deep and wide ranging expertise relevant to smallholder forestry in Indonesia. The different people interviewed expressed views that reflected their role and responsibility. For example, smallholders focused on likely ways to improve their family's wellbeing (which may not involve tree growing), company staff focused on ways to encourage smallholders to grow more wood, provincial agency staff focused on ways forestry could support regional development, and national policy makers focused on ways to incentivise smallholders to establish and manage large areas of forests. This stage of the process revealed that there are multiple, and at times conflicting, views of what smallholder forestry could, and should, achieve, highlighting a complex operating and policy context. Individual interviews provided information strongly framed by the individual's professional experience and on-going interest in CBCF:

- government – strategies to get more forests established;
- industry – strategies to secure more reliable supplies; and
- farmers – strategies to enhance household incomes and livelihoods.

Not all strategies to 'enhance' smallholder forestry were aligned or complementary, as establishing large areas of forest plantations, for example, may generate little income for smallholders, compared to agricultural commodities. Interviews also tended to reflect an individual's geographic experience, with those experienced with commercial forestry surrounding large provincial or capital cities more enthusiastic about the commercial viability of smallholder forestry.

There were 34 participants involved in the three interactive workshops to explore the past and likely future influences on CBCF, with the invited participants drawn from different levels and roles in government, non-government organisations, private sector, academics and farmers – all recognised to have deep experience relevant to CBCF. The 'foresight analysis' component of this project is described in the project report by Digby Race *et al.* 2021.

HTR (community forestry program) assessment

The project team investigated the constraints to the development of the HTR scheme and the factors influencing its success, to provide recommendations for policies to enhance the HTR's implementation (activity 3.3). This component of research was framed by the following questions:

1. What is the extent of the HTR's implementation in the field?
2. What are the constraints to the development of the HTR and the factors influencing its success?

The HTR assessment used qualitative research methods – utilizing literature review, FGDs, face-to-face interviews, and in-depth review of selected case studies, that were grouped into primary and secondary data. The data were analysed using qualitative methods. The strengths of this method is the research can progress step-by-step in

several stages (Denzin and Lincoln, 2005), which can be systematically organised to suit the limitations of this project, in terms of time and budget. Using a qualitative method can also provide insights from the data while the analysis is in progress (Richards & Morse, 2007). With several corporations and villages included in this research, we employed a multiple-case study approach because of the varying characteristics of the different locations (Cresswell, 2007). Lampung and Gorontalo were selected as research sites for this study (a more detailed description of the study sites is provided above in Section 5 Methodology).

The fieldwork was conducted in 2017 with two visits to each research site, with one week duration per visit in each village. Relevant literature was reviewed from scientific journal articles, policy briefs, policies and regulations, books, newspaper and magazine articles, websites, and other sources such as documents of presentations and statistics. Also, to seek perspectives from stakeholders about the HTR policy and its implementation, FGDs were conducted in Jakarta, Lampung and Gorontalo, as well as field-based observation at two research locations in Budi Lestari village, Lampung province and Rumbia village, Gorontalo province. FGDs and face-to-face interviews involved policy makers (from the central and provincial governments), director and staff from private companies of timber processing businesses, director and staff of several non-government organizations (NGOs), university-based researchers, and members of local communities, derived from both face to face in-depth interviews (*n*=52) and four FGDs (*n*=80). The FGDs were conducted once at Jakarta and twice at the provinces of Lampung and Gorontalo, and once at Forest Management Unit of Gedong Wani, South Lampung.

The data collecting was organised by interviewing members of local communities holding HTR permits (*n*=15), policy makers at central and local governments (*n*=18), staff of private companies (*n*=8), staff of NGOs (*n*=6), and researchers at universities (*n*=5). The interviewees were selected by means of snowball sampling. The key persons were being interviewed, flowing from the information of the previous interview about who are strongly related to the HTR implementation in Lampung and Gorontalo provinces. Prior to interviewing members of the local communities, field observations were conducted to explore the location of the HTR area, the plantation conditions, accessibility, potential markets, modes of transportation for timber haulage, and the local HTR administrative procedures. Stakeholders from NGOs and universities were interviewed to explore how far the implementation of HTR had progressed and the progress of community assistance. Data and information from private companies were reviewed to find out the raw materials needed for the timber industry, and also the constraints and possibilities to link-up smallholders to industry.

Descriptive and thematic content analysis of the qualitative data was undertaken. The application of thematic content analysis identified interrelated themes and patterns for further analysis. This form of analysis was thus helpful in identifying and analysing common issues that emerged from the interviews. The themes were grouped into positive or negative opinions. These opinions were further investigated and discussed to address each research question in detail. Thematic analysis is seen as a foundational method for qualitative analysis (Braun and Clarke, 2006). One of the benefits of thematic analysis is its flexibility, being a method that is essentially independent of theory and epistemology (Aronson, 1994; Braun and Clarke, 2006; Roulston, 2001). Through its theoretical freedom, it provides a flexible and useful research tool that can potentially provide rich and detailed, yet complex, insights.

Another strength of qualitative data analysis is that it can enable the research to progress in a step-by-step manner (Denzin and Lincoln, 2005). Using a qualitative method can also provide insights from the data while the analysis is in progress (Richards and Morse, 2007). An advantage of this can be the creation and development of theories (Ridder, Hoon and Balluch, 2014). The research would also provide input for policy makers to enhance HTR implementation, although the policy community rarely sought policies from researchers, instead research would be commissioned to confirm a preferred policy option

(Silverman, 2016). The 'HTR assessment' component of this project is fully described in the project report by Kristiana Tri Wahyudiyati *et al.* 2019.

CBCF Policy analysis

This component of the project analysed the current policy context for CBCF in Indonesia and the supporting policy reforms that would enable it to become a profitable investment choice for smallholders (activity 3.4a). An analysis of the policies, programs and regulations that influence the adoption and viability of CBCF was undertaken, with an integrated analysis of the government, related stakeholders, and private sector perspectives. The study aimed to answer the following research questions:

- How have the forest policy reforms to support communities been underway at the multiple tiers of government and how has the central government overcome the socio-economic and political handicaps?
- How has the institutionalization of policy reform (i.e. CBCF) been undertaken at the multiple tiers of governments?
- How have related regulations vertically and horizontally connected to and influenced the smallholders and manufacturing industries?

The project team used a multi-level analytical approach involving macro-, meso- and micro-level analyses. The study analysed the interplay between these three levels of policy within the context of CBCF development. The analysis focused on explaining the relationship between regulations in the forestry sector and other related sectors. These regulations are related to the right to access and control of forest resources, regulations related to timber trade or product markets, and regulations governing the timber industry sector. This approach illustrated the relationship between government prescribed regulations at the national, provincial and local levels.

The project team also incorporated an analysis of the private sector's interests in CBCF. This was done using a staged process: review of policy and company documents; in-depth interviews with selected senior policy makers, program managers and company staff; presentation and discussion of a draft report at a policy workshop; and a revised report and recommendations presented at policy workshops and 'policy labs'. In-depth interviews were conducted with 14 national-level key informants that included policy makers, university-based researchers and representatives from NGOs and the Indonesian Forest Corporation Association (APHI). Numerous provincial-level interviews were also conducted. In Gorontalo, the experiences from 20 respondents included provincial policy makers from related institutions, such as the Forestry Services, Watershed Management and Protected Forest Technical Units Agency (BPDASHL), State Forest Technical Unit Agency (BPKH), NGO officers, farmers, the head of the Forest Management Unit (FMU), heads of farmer groups, a village chief, the head of a youth organization, and the Director and Managers of an industrial forest plantation company. In Lampung, 22 respondents shared information with the project team, who included provincial policy makers from related institutions (i.e. Forestry Services, Provincial Planning Agency, BPDASHL, BPKH, Production Forest Management Technical Unit (BPHP), NGO officers, timber traders, heads of cooperatives, farmers, the head of the FMU, heads of farmer groups, forest extension officers, owners of businesses within the timber industry, and the owners and manager of a timber corporation. The interviews with key informants lasted on average about 2-4 hours. Interviews were undertaken in the office and also outside the office, such as at hotels or cafes, depending on the willingness and convenience for the targeted informants.

We also conducted a series of FGDs involving relevant stakeholders from the central government, provincial government and village government levels. At the central level the project team involved 30 stakeholders in the discussions. This FGD aimed to explore the current status of and the issues associated with social forestry (e.g. CBCF) policies. We also undertook provincial- and village-level FGDs. In Gorontalo, 15 stakeholders

participated in the FGD, while the village-level FGD involved 20 farmers. In Lampung, the FGD involved 15 stakeholders, while the village-level FGD involved 7 farmers. Here, we also held a FGD with the Forest Management Unit involving 15 people. At the provincial level, the FGD aimed to identify problems associated with the institutionalization of the SF policy in the regions. The village-level FGDs aimed to explore the field-based problems experienced by farmers and farmer groups in relation to forestry programs and regulations. In addition to in-depth interviews using open-ended questionnaires, primary data was also collected using a structured questionnaire, with19 respondents from the national level and 26 from the provincial level. The 'CBCF policy analysis' component of this project is fully described in the project report by Lukas Rumboko Wibowo *et al*. 2019.

Policy labs

Policy making is not a routine bureaucratic process, but a process that involves many actors and interests (Wibowo, Race and Curtis, 2012). Indeed, the success of CBCF policy is also determined by the capacity to incorporate and reflect the interests and aspirations of different actors engaged in the institutional landscape of commercial timber production and marketing. In addition, the social and political interaction among different sectors and policies of related institutions significantly affect the success of CBCF. One component of the project was to design and conduct a 'policy lab' to assess its value for the project to impact the policy making process (activity 3.4b). This activity aimed to establish an open dialogue and in-depth discussion among a group of policy makers across different portfolios associated with CBCF in order to provide constructive input in preparation of reports, policy recommendations and policy briefs as outputs of the project. Given the complexity of most policies, the 'policy lab' provided a forum for a network of different actors to interact with each other in a 'safe' environment.

The policy labs were aimed at the mid-level policy-maker who will have time to be involved in the process and with sufficient experience to add value to the dialogue. The policy lab applied a deliberative approach in its discussion in which all participants had an equal position and that all participants could express their opinions openly. The policy labs were conducted about once a year with a variety of topics related to the various policies linked to CBCF, challenges and implications and possible improvements / refinement of the policy. The project team conducted four policy lab workshops held in Jakarta where the policies are mainly developed and formulated. The policy lab component of this project is described in the project report by Aneka Prawesti Suka *et al*. 2021.

Regional discussion forums

The regional stakeholder forum (activity 3.5) was first identified as a potentially useful means for the multiple stakeholders involved in smallholder forestry to come together to discuss their roles in CBCF in Bulukumba during an earlier project (FST/2003/025). It was popular and valuable and so continued during following projects (FST/2008/030 and FST/2015/040). The context for CBCF is dynamic with changes regularly occurring, such as changes in government organizations, policies and regulations, declining and emerging demand by the wood processing industries, land-use change by farmers as enterprises fluctuate, price fluctuations of timber and other commodities. The regional stakeholder forum provided all stakeholders with an opportunity to openly discuss these changes and the implications for growers, processors and others involved in the value-chain. The forum also established a degree of understanding and trust among the participants, and enabled solutions to be developed to address local issues.

The key steps in establishing and conducting the stakeholder forums were:

1. identification of community forest management stakeholders
2. establishment of communication through the role of related technical agencies, the role of the Contact Person (organizer), the role of community leaders, and the role of successful farmers;
3. stakeholder and institutional analysis;
4. regular visits and intensive communication; and
5. facilitated thematic / topical meetings.

Participants of the different stakeholder forums varied to include farmers, FFGs, village governments, community leaders, various offices/services of local and provincial governments, representatives from MoEF (central government), extension officers, private sector staff, academics, staff from relevant business associations (e.g. furniture manufacturers) and NGOs.

The most active stakeholder forum organized by this project (FST/2015/040) was at Bulukumba, where the forum was held every year from 2017 to 2020. The key topics for discussion in each year were: ‘Updating the role of every stakeholder in community forest management in Bulukumba’ (2017), ‘Facilitating '*draft ranperdes*' process within the Malleleng village government’ (2018), ‘Public consultation on the substance of Village Regulation (draft *ranperdes*)’ (2019), and ‘Implementation of village regulation on sustainable community forest management and its scaling-up opportunity in Bulukumba’ (2020).

At other sites, the frequency and topics of forums varied. For example, in 2019, the stakeholder forum held in Boalemo and South Lampung discussed the MTG training course (that was subsequently held in each location). In 2021, the stakeholder forums held in Bulukumba, South Lampung, Pati and Gunungkidul shared the project’s overall results and publications.

The key lessons identified by the project team from the stakeholder forums were:

- conduct identification of stakeholders and stakeholder analysis (important first step);
- build a long, trusted and strong relationship with the different local partners / stakeholders;
- be prepared to commit to supporting the forum for many years;
- ensure funds are available for repeated visits and meetings with various stakeholders;
- conduct the stakeholder forum regularly (at least once a year); and
- follow-up on the results from stakeholder forums by the different institutions participating in the forums (ensure the agreed action happens).

7 Key results and discussion

In this section, the project team provides a summary of the key findings, results and discussion about what has emerged from the 5-year research and development project that aimed to understand what makes community-based commercial forestry (CBCF) work in Indonesia. As many smallholders already know, a successful forestry enterprise takes much more than growing trees. Reflecting the complexity of CBCF, the project explored the economic, institutional, market, policy, silviculture and social components of smallholder forestry – learning from the past, analysing the present, and forecasting the future. The project team collaborated with tree growers, market brokers and contractors, company owners and field staff, program managers and policy makers, industry analysts and researchers, to understand a wide range of perspectives about what makes CBCF successful.

While the broad aim of the project is to inform how we develop CBCF across Indonesia, the country is so diverse that the opportunities for CBCF vary widely. The project team focused its effort in five districts with very different characteristics: Bulukumba (South Sulawesi), Gunungkidul (Yogyakarta), Pati (Central Java), South Lampung (Lampung) and Boalemo (Gorontalo) (the study site locations are described more fully in Section 5 Methodology). The key findings and lessons discussed below reflect the situation of these study sites, but are also thought to be relevant to many other parts of Indonesia.

Markets for timber

There is strong demand for a range of timber products (e.g. sawn boards, veneer, furniture and appearance timber) throughout Java and in major centres of urbanisation (economic development) – mainly in cities with a growing population of more than 500,000 people (Indonesia has 27 cities with >500,000 people), mostly in Java, Bali and Sumatra. The process of urbanisation is continuing, with one estimate indicating that by 2025, more than 67% of Indonesia's population will live in urban areas (World Bank 2010). Even in some regional areas, the population density is high – about 55% (about 150 million) of Indonesia's population of 275 million lives on Java (Statistics Indonesia 2021).

Timber grown by smallholders is mostly sold into local and provincial value-chains, whereby smallholders sell their standing trees to local market brokers, who in turn organise the harvesting, transport and preliminary processing, or transport to large integrated processors and manufacturers. Species, timber quality and volume mainly determine the price offered to growers, with prices generally satisfying growers if they are living in the vicinity of competitive markets. In rural areas that are remote from centres of economic development, commercial timber production is often not very profitable for smallholders compared to commodity (e.g. cassava, rice) and cash (e.g. coffee, rubber) crops.

Smallholders and supporters of CBCF need to analyse the comparative advantage of small-scale forestry in the local context before advocating for the widespread adoption of commercial forestry. Government programs may be able to offset some of the costs and limitations of establishing CBCF as a viable industry within a local context (Permadi *et al*. 2020), but policy interventions need to be carefully designed and implemented so programs do not distort the market signals that smallholders are likely to receive over the medium to longer term.

Land-use options for smallholders

This study examined the adoption of tree farming by smallholders in the districts of Pati and Bulukumba, Indonesia, with the key findings of the study presented below.

Firstly, the transition from farmers growing agricultural crops to tree crops, especially outside of existing forestland, is occurring on a noticeable scale at the village and/or district levels. There has been considerable land use change among smallholders in Pati during the period 1950 – 2018, with cultivated agricultural land shifting to private forests and, to a lesser extent, forest land to cultivated farm land. The change in land use during this period (i.e. nearly 70 years) has resulted in a net increase in the District's net forest cover from 33% to 58%. Similarly, in Bulukumba, about half of the area change in land use during the period of 1956-2016 (i.e. about 60 years) involved the conversion of cultivated agricultural land (mostly growing corn) to family-based commercial tree plantations – mainly teak and gmelina (*Gmelina arborea*).

Secondly, the practice of private forestry has increased significantly in Pati, with the two main species grown being sengon and teak. Teak plantations have been adopted by the District's smallholders since the 1950s, while sengon plantings commenced and have increased in scale more recently since the 1990s. The adoption of teak began to increase significantly in the 1980s, and the adoption of sengon increased markedly in 2000s. In Bulukumba, the four main commercial tree species that have mostly contributed to the land use change are teak, gmelina, bitti (*Vitex cofassus*) and sengon. In this District, the earliest teak plantation was established in the 1950s and plantings of this species increased significantly 20 years later. Bitti was introduced to the District in the 1960s and its adoption by smallholders also gradually increased alongside teak. Sengon and gmelina were first introduced almost at the same time in 1990s, but gmelina has proven to be the more popular species, with an adoption rate far higher than sengon. In both Pati and Bulukumba, there has been a time lag between the first introduction of the tree species for commercial timber production and their adoption peak which requires further study.

Thirdly, in Pati, the adoption of tree plantations by farmers was generally diffused through neighbours, friends and family (in the case of teak) and extension services, especially non-governmental organizations (in the case of sengon). In Bulukumba, the adoption of tree farming was triggered by both family members and the government agency extension officers – at both the village and district levels. This shows that farmer-to-farmer learning and collaborating with extension services could lead to increased adoption in any future innovation program.

Fourthly, in Pati, the economic benefits due to increasing demand of the local timber market and the availability of mills for regional processing of logs had encouraged farmers to adopt tree farming, especially using fast growing tree species. In the case of teak, the main motivation for farmers to plant the species was for a long-term investment and subsistence uses, while for sengon the main motivation was the rising price of sengon timber and the potential for this species to be more profitable during a relatively short period of time (e.g. 5-8 years). In Bulukumba, gmelina has been gaining in popularity over the last two decades due to its faster growth compared to teak and bitti, and because its timber is good for house construction and commercial sales, although its market potential has been uncertain in recent years.

Fifthly, implementation of appropriate silvicultural practices (fertilizing, pruning, thinning) by smallholder tree growers in both Pati and Bulukumba was limited. Increased technical assistance from the government and non-government extension officers could increase the farmers' awareness, knowledge and skill for using the recommended silvicultural practices. However, the costs of intensive silviculture may be a major constraint for some smallholders. Thus incentives, such as a government subsidy to provide simple tools to conduct pruning, for example, may be required to boost the rate of adoption of silviculture among smallholder farmers. Also, further research about the effectiveness of low-cost silvicultural options appropriate for smallholders should be pursued.

Lastly, the economic return of tree farming was still below what was anticipated by many smallholders contacted for this study, mainly due to the long harvesting cycle and the low prices received for timber at the farm level. Consequently, there is a strong possibility that many current teak growers will replace their long-rotation teak with shorter-rotation tree species (e.g. sengon) or cash crops, reducing future supplies of teak from smallholders. However, some smallholders also reported that they were considering converting their sengon plantations to cash crops, such as cassava and oranges, which are currently thought to be more profitable. The quest for short-term profits is considered the chief reason for smallholders changing their commodity production. Nonetheless, most farmers still retain some areas of forested land of teak, sengon or gmelina. There is a need for further investigation of the rate of cessation of smallholder tree farming, so that we can more accurately compare the probability of adoption or rejection of tree farming and the primary factors affecting farmers' decisions.

Financial models of sengon and teak in smallholder forestry

Smallholders typically view CBCF as a relatively passive enterprise compared to most agricultural enterprises, with little effort given to pruning or thinning trees as a forest grows. However, with appropriate silviculture at key stages of a tree's growth, CBCF could be a much more profitable enterprise for smallholders. For example, analysis shows that a small forest of sengon (*Paraserianthes falcataria*) could generate an internal rate of return (IRR) of 20% and a small forest of teak (*Tectona grandis*) could generate an IRR of 15% in Central Java, if well managed. Smallholders understand the concept of how their management of crops and livestock affects the market price they receive, yet this concept is not commonly applied to commercial trees. Financial models constructed by the project team indicate how smallholders can manage their investment of time and farm resources for a well-managed forest so that it becomes a highly profitable enterprise (Stewart *et al*. 2020) (see Figure 2 below). The financial modelling also illustrated how small-scale forestry could be developed on a regional scale, such as via the HTR program, to create an economically viable forest industry.

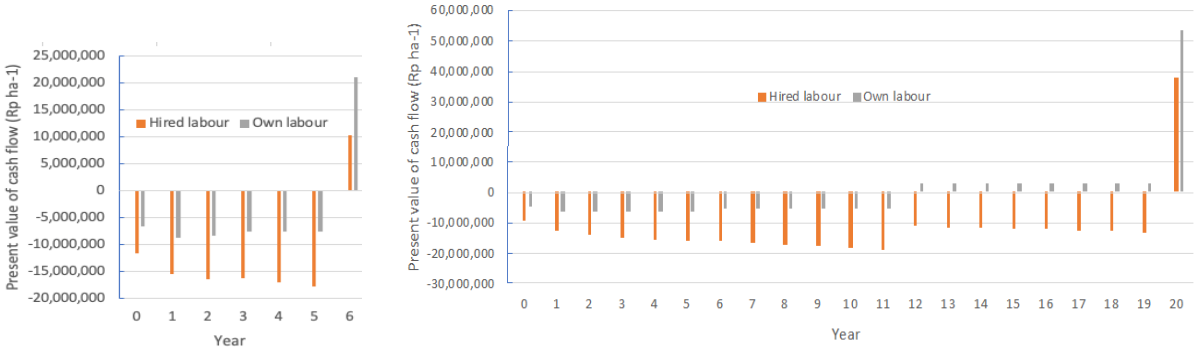

Figure 2: Cumulative cash flows (on a present value basis) for smallholder sengon (left graph) and teak using hired labour versus own labour, Central Java [Note different vertical scales.]

We focus our discussion on interpretation of the results of the models, how the models might be used, and the key decision points for smallholder growers. We modelled an intensive silvicultural system – fertilisation, weed control, thinning and pruning, but no use of fungicides or pesticides – rather than a 'plant and watch them grow' attitude to silviculture that will not maximise the productivity, quality, or value of the teak (Dieters *et al*. 2017) or sengon. The framework and methodology provided can be used to model different silvicultural systems with log outturns adjusted accordingly, to test smallholder preferences for investing in forestry. This could inform individuals and group discussions about options for timber production and critical decision points regarding the investment. Specific channels through which to disseminate the findings include individual growers via

the Master TreeGrower program being implemented in Indonesia (Reid 2017, Rohadi *et al*. 2018), partner organisations (e.g. District forestry staff), NGOs (e.g. Trees4Trees), and other supporters of smallholder forestry.

The results we present are not a recipe to follow but are illustrative of the potential viability of sengon and teak for smallholders, keeping in mind the need to adapt management to local commercial reality and individual needs and capabilities. As noted by Reid *et al*. (2015), almost by definition the variability in site fertility, genetic material used, silvicultural techniques, competition from crops and nearby established trees, and landholder objectives mean that for smallholders an age-based guideline for the implementation of silviculture may not be appropriate.

Research over the past decade concluded that the greatest opportunity for enhancing farmer returns lies in remedying poor silvicultural management, particularly the lack of effective pruning and thinning (FAO 2019, Race and Wettenhall 2016). The use of planting material of better genetic quality is also of importance as the difference in productivity between improved and unimproved planting material can be quite large. Attention to initial spacing between trees and the timing and intensity of thinning is essential as these factors are the most important silvicultural determinants of tree growth and development in managed stands (Evans and Turnbull 2004). Choice of initial stocking involves trade-offs between costs of establishment, weed control and pruning, and timber yield and log quality. For example, lower stocking (i.e. wider spacing) may be cheaper to establish and prune yet more expensive to weed; higher stocking more expensive to establish and prune but cheaper to weed and likely to produce stands with smaller logs and less uniformity due to greater inter-tree competition.

Smallholders often manage their timber plantations using poor silvicultural practices because of a lack of capital to invest in teak management (Rohadi *et al*. 2012). Results from these models developed in this research could be used to estimate the net benefits of capital investment in improved silviculture, and the results of such modelling could inform a case to obtain finance for such investment. Teak production requires relatively long periods of capital investment and robust information on expected economic returns are essential for the wise use of capital. Knowledge of the financial implications of harvesting plantations prematurely is important for growers with cash requirements – that is, to understand the benefits foregone if plantations are harvested before the optimum rotation age for the silvicultural system being applied.

Universally log prices were well correlated with log diameter. We modelled a sengon plantation with a medium initial stocking and applied thinning to add value to the retained trees (increased diameter) and to reduce variation in log quality compared to a stand that received no silvicultural treatment. Our thinning regime provided a selection ratio of about one tree felled at the final harvest for every three trees initially planted. As seedling material of better genetic quality becomes available for smallholders, initial planting densities may be able to be lowered while still producing high quality crop trees in the final harvest.

For teak we modelled a stand with an initial stocking set at the level currently recommended for smallholder plantations and applied pruning and thinning to grow high quality sawlogs. Sawmillers and numerous observers report that the quality of teak grown by smallholders in Java and on other Indonesian Islands is almost always lower than that sourced from professionally managed forests and, as a result, the prices paid to smallholders are lower. The lack of effective pruning and thinning are the most significant factors downgrading price and quality of logs produced by smallholders (Reid *et al*. 2015). Our silvicultural system included two thinning operations. We suggested that the first thinning could be a pre-commercial, or silvicultural thinning if there were no ready markets for small-sized trees. We note that smallholder teak growers of Laos are reluctant to remove trees without a financial return from the sale of the timber, and pre-commercial thinning is perceived as a waste of time and timber (Pachas *et al*. 2019b), and that in a study in Gunungkidul most farmers viewed thinning as a loss of future income rather than

improving the quality and value of the remnant stand (Roshetko *et al*. 2013). These perceptions highlight the importance of extension of our results to convince farmers of the merits of thinning.

We assumed that the sengon logs would be used to manufacture wood panel products, which can be made from small-sized logs. Final harvesting trees at the age of 5-7 years may lead to a high proportion of juvenile wood in logs, with lower density and lower strength properties than mature wood (Darmawan *et al*. 2013). However, juvenile wood is of little concern when manufacturing such products as barecore and plywood. On the other hand, juvenile wood is an issue if logs are processed for sawnwood and furniture industries. Managing sengon on longer rotations will increase the proportion of mature wood and potentially the log value because of improved wood quality making the timber suitable for such solid wood products as furniture, apart from any value increases due to larger log size. Another advantage of longer rotations that produce larger-sized logs is that there is less wastage of merchantable timber in the process of merchandising logs – that is, cutting a felled and delimbed tree into logs destined for different products (e.g. plywood, sawnwood) each having their own price and specifications for length, diameter, and defects. For example, Kurinobu *et al*. (2007) found that for sengon the volume loss in merchandising logs was over 40% for trees with a diameter (measured 1.3 m above ground) of 20 cm, while it decreased rapidly to reach less than 10% at a diameter above 25 cm. For teak in Central Java, log diameter is used as a proxy for the amount of heartwood which is a main factor that determines the wood quality of teak and hence the value of teak logs. Longer rotations are an important factor in producing a large diameter logs with a higher proportion of heartwood (Fujiwara *et al*. 2018). Further investigation is required to understand the significance of rotations longer than the 20 years we modelled for heartwood proportion and hence increased value of teak logs.

The results from our financial analyses of timber production by smallholders in Pati indicated an IRR of 20% for growing sengon on a 6-year rotation, and an IRR of 15% for growing teak on a 20-year rotation. Comparable results for smallholder timber production are 14% for a teak plantation over a 20-year rotation in Java (Midgley *et al*. 2007); 15-20% for teak plantations over an 11-year rotation in Lao PDR (Maraseni *et al*. 2018); 19% for sengon plantations over a 5-year rotation in West Lampung district, Sumatra (Herawati 2013); 24-35% for acacia plantations over a 5.5-year rotation in Central Vietnam (Flanagan *et al*. 2019); and 36% for balsa (*Ochroma pyramidale*) over a 5-year rotation in Papua New Guinea (Midgley *et al*. 2010). Our result for teak suggests it is a viable option for good quality land, rather than mostly being established on degraded lands as is the case in Java (Budiadi *et al*. 2017).

While for simplicity we modelled investment in sengon and teak as monocultures, we recognise the rich diversity of smallholder agroforestry land management. The analytical approach we developed could be readily used to model intercropping with staple commodities traditionally cultivated by smallholders, with the benefit of early cash flow. Traditionally, teak plantations in Indonesia have been planted in association with an agricultural crop which controls weed growth; once the trees approach crown closure, the agricultural component becomes unviable and is moved to another site (Midgley *et al*. 2007). Siregar *et al*. (2007), for example, showed that a sengon-corn agroforestry system in East Java was profitable for smallholders. If sengon or teak was established using an agroforestry system, the trees would be planted at wider spacings than in our models to allow for the production of agricultural crops, perhaps at densities in the range of 600-800 trees ha^{-1}. In agroforestry systems synergies are created – for example, management costs for fertilizers and weeding for teak are associated with those for annual crop production (Roshetko *et al*. 2013).

Our analysis revealed long lag periods before the investments in sengon or teak became cash positive. This adds to the pressure to harvest early or in some known cases for smallholders to abandon their forests and return the land to annual crops. It highlights the benefit of bridging the exposed period to forest maturity through agroforestry systems or

other multi-year financing facilities to maintain cash flow for smallholder families. Alternatively, the government and various NGOs have offered free seedlings and planting materials to make community-based forestry more attractive to a broader population. Without such facilities, community-based forestry is out of reach for many lower income farmers.

Our farmer interviews indicated that some smallholders rent land to grow sengon. We were unable to discover reliable estimates of commercial rates to rent land suitable for sengon or teak in the study area. A somewhat dated reference (Midgley *et al*. 2007) reported an annual land rental of Rp 500,000 ha^{-1} for growing teak in Java over a 20-year rotation. An analysis of land prices in Jambi district, Sumatra, from a survey of more than 700 farm households showed that the median market prices for land in 2015 were Rp 25,500,000 ha^{-1} for plantation land, Rp 8,000,000 ha^{-1} for grass and bush land, and Rp 4,900,000 ha^{-1} for forest land (Krishna *et al*. 2017)[6]. If we assumed plantation land could be rented for 5% of its market value, the annual rent would be Rp 1,250,000 ha^{-1}. If such annual rentals were factored into our models, the investments in sengon or teak would remain financially viable. This knowledge is important given that a threat to community and smallholder forestry is the pressure to convert forest land to agricultural production (de Jong *et al*. 2016).

The results indicate that if sengon and teak plantations are established, managed and marketed as modelled, the investment is profitable with earnings well in excess of the target rate of 8% real rate of return. A flow-on is that the forestry enterprise could afford to pay wages of silvicultural workers at rates similar to urban workers and well beyond the minimum district wage, making forestry attractive to family labour compared to off-farm work, particularly for families with surplus labour. We draw this conclusion from an analysis of trends in the Indonesian labour market which found that urban and rural people have disparate labour market outcomes (Allen 2016). Specifically, in 2015, the average monthly wage of casual employees in agriculture was Rp 0.8 million, casual employees not in agriculture was Rp 1.3 million, while regular employees earned Rp 2.1 million on average. Allen (2016) held the view that ensuring that labour is able to shift from low-paying agriculture jobs to higher paying jobs in the industrial and services sector is critical to boosting incomes and labor productivity in Indonesia. We contend that if smallholders achieved the potential of commercial forestry there would be a sizeable increase in rural income for tree investors and casual workers in rural areas, which would help to shift agriculture, in which 34% of employed people work (Allen 2016), away from being a low-skilled, low-paying sector with a diminishing workforce.

Matching of species to the biophysical characteristics of a site is a critical factor for the success of forestry or agroforestry systems (Sabastian *et al*. 2018). The over-reliance on a few species can limit forestry options in heterogenous landscapes (e.g. the study area), heighten the ecological risk in the form of pest and disease impacts, and may increase the market risk as consumer preferences change (e.g. from light-coloured to dark-coloured timber for appearance products). While the results of this study apply to the concept of sengon and teak managed as even-aged monocultures, the models we developed provide a framework for comparative analyses of the economic viability of other tree species. This could include timber production from mango (*Mangifera indica*) and jackfruit (*Artocarpus heterophyllus*) for processing into sawnwood which has become important for smallholders in recent years (Maryudi *et al*. 2015).

The NPV for teak was nearly three times that for sengon at a discount rate of 8% (Rp 39,408,000 ha^{-1} versus Rp 14,218,000 ha^{-1}), though the LEV indicated that in the long term (i.e. over perpetual rotations), the returns from teak and sengon, being enterprises

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[6] *Plantation land was used almost exclusively to cultivate oil palm and rubber; grass and bush land was former forest land where timber had already been extracted and was sometimes difficult to distinguish from degraded forest; forest land was land where trees still existed (Krishna et al. 2017).*

with significantly different investment periods, were closer (Rp 50,173,000 ha^{-1} versus Rp 38,444,000 ha^{-1}). However, these results were sensitive to the discount rate – at 4%, teak would clearly be the most profitable investment whereas at 12%, the profitably of teak and sengon was similar, as indicated by LEV. When discount rates are large, cash flows further in the future affect NPV less than when rates are small; thus, revenues at 20 years in the future for teak have less impact on the NPV and LEV for a discount rate of 12% versus 8% while the change in discount rate has no impact on the establishment costs of the plantation incurred in year 0.

Household surveys in 2013 and 2015 in Pati showed that smallholders across all wealth categories (low, medium, high) were investing in forestry, though the data did not identify the type of forestry (Race *at al*. 2019). In making land-use decisions involving forestry, a relatively young cohort working off-farm might prefer a long-rotation species because the cash flow might suit their long-term income needs (e.g. superannuation), the investment could build a family legacy, and the species (teak) is likely to have both demand and price upside due to its global recognition and diminishing supply from traditional sources. Such investors might consider engaging professional management that aggregates plantation resource to achieve better product and market returns. By contrast, sengon has the appeal of being a short rotation investment and having a domestic demand that does not appear to be abating in the short-term. Farmers are ageing, which reinforces why forestry might be an attractive land use; older farmers might consider sengon to be a more realistic prospect due to the lower silvicultural inputs and because it is not beyond their time horizon which might not be the case for teak. Moreover, a household with constrained household labour or cash to hire labour might choose a less intensive regime, with the likelihood of lower net profit from the tree crop.

Smallholders are seeking more off-farm income (Race *et al*. 2019). Forestry appears to provide an opportunity to the increasing proportion of entrepreneurial smallholders who are supplementing income from off-farm sources, due to the lesser intensity of management over the growing period compared to agricultural crops. Given our results that indicate that forestry is a feasible investment, we argue that it is not a diminishing prospect for smallholders.

While the models we developed indicate that forestry can be profitable for smallholders, successful and sustainable development of regional forestry can be limited by a lack of scale, recognising that the scale for sustainable land use can vary considerably depending on the location, markets and capacity of growers. We believe that the 'community plantation forestry' (HTR) program offers a unique opportunity to develop commercial sengon and teak forests at scale on land with a low opportunity cost, underpinned by government policy, commitment and resources. The models we developed could be used to plan and implement such investment to make HTR workable at a regional level. Since the land is state-owned and there is a Central Government policy decision to develop designated parts of the land base for community-based commercial forestry, we argue that the opportunity cost of such land is negligible and hence no land rental would need to be factored into the investment model. This would create a necessary momentum shift in community-based commercial forestry, given that increasing demand for timber has emphasised the need for commercialization of smallholder forestry in Indonesia (Maryudi *et al*. 2015).

We also explored how professional forestry management and coordination might be applied to implement a project supported by the HTR program. This approach offers a different paradigm – a dedicated team of professionals working for the local community, while the community and government can be assured of expert and timely management – a common shortcoming of smallholder forestry. A consolidated estate would overcome the issue of an inconsistent supply of small quantities of logs of various species and grades, as is often found in smallholder forestry (Race and Wettenhall 2016). The program would directly enhance regional economic development as smallholder commercial forestry became more reliable and sustainable. In effect the forestry manager would be carrying

out the traditional role of middlemen in marketing the timber but working solely in the interests of growers in negotiating sales agreements with wood buyers. Higher production costs per unit of wood produced in smallholder forests has been cited as the main reason for why smallholder timber growing may prove less competitive than larger, industrial forestry (Maryudi *et al*. 2015). We argue that the approach we advocate should go some way to bridging the gap between the unit costs of timber production for community and industrial forestry.

Scale, coordination and professional management would facilitate viable voluntary certification of community-based commercial forestry under the internationally recognised Forest Stewardship Council scheme, which otherwise is proving difficult for small, discrete plantings (Stewart *et al*. 2015). Such certification provides an independent view of the social acceptability and ecological sustainability of the forests under management.

For a range of reasons, community forestry practitioners and researchers have largely ignored the role of sound silviculture in community-based commercial forestry. Importantly, the silviculture needed for this type of forestry to produce the range of goods and services that smallholders and communities require may be quite different from that applied in large-scale industrial forestry (FAO 2019). In the implementation of the HTR program, government has a critical ongoing role in conducting such research to underpin best practice.

Forest certification

Certification that timber has been produced legally and sustainably has become an increasing requirement for international trade (e.g. FSC certification), however the project team found this has generally not led to expanded or new markets for smallholder forestry as the cost of the certification process usually exceeds an additional increase in timber prices. Larger NGOs or companies have funded forest certification processes among smallholders, yet these initiatives are usually viewed in terms of achieving longer term targets or meeting ‘social licence’ goals. At this stage, there is little economic incentive for smallholders to undertake FSC certification independently, so joining larger district-wide initiatives or growing trees under contract to larger projects or companies appears the most feasible (Rohadi *et al*. 2020). Even then, certification will need to add value to the whole value-chain for all stages to invest in the verification process.

Indonesia has also introduced the Timber Legality Verification System (SVLK) to ensure only timber from legal sources is processed and exported to markets such as in Europe. Smallholders can easily self-declare the legal origins of their trees, so the timber can then be sold to S-LK certified processors and then exported. However, research has found that the high cost of verifying timber along an extended value chain, particularly for infrequent and small supplies (e.g. from smallholders) was difficult to sustain for CBCF (Susilawati *et al*. 2019). Also, when the value chain includes timber from a wide range of sources, as often occurs with CBCF, certified timber can be ‘blended’ with uncertified timber – masking the origins of timber in a manufactured product (Susilawati *et al*. 2019).

Smallholders with knowledge and skills

A poor understanding of silviculture (tree management) by smallholders is frequently reported to undermine the potential commercial returns from CBCF. To address this gap in knowledge and skills, the project team has adapted the Master TreeGrower (MTG) training course to the Indonesian context and have delivered 21 courses since 2014 (Muktasam *et al*. 2021), with additional courses self-funded and delivered by Indonesian agencies. Over 400 smallholders have undertaken the MTG’s innovative training, which has a focus on growers’ understanding the local market place, tree management and measurement, how silviculture links to prices, risk management, agroforestry and non-timber forest products (Reid 2017). A feature of the farmer-centred training of the MTG course is that it takes growers to the market place so they can hear, see and understand the dynamics of how timber is priced at the ‘finished’ end of the value-chain. Post-training

evaluation indicated that more than 50% of MTG participants have changed the way they manage their forests and planted additional trees with more confidence in their silviculture and commercial value (Muktasam *et al*. 2019). Participants have also been encouraged to share their experience and knowledge with their neighbours, with support given via the farmer-to-farmer mentoring initiative.

Re-designing the MTG training courses

The contents of the re-designed MTG training courses conducted across the many locations for this project were similar in that they all covered the main topics: *introduction to the MTG, motives of growing trees, timber markets, trees and log measurement, farm and tree management*, and *risk management*. Additional subjects were included as appropriate to each course such as forest farmer groups, non-timber forest products, nursery practices (particularly for women), and agroforestry practices.

The financial models prepared for farm-grown sengon and teak based on data from Pati (Central Java) found well-managed trees could be a very profitable enterprise for smallholders, with sengon having the potential to achieve an IRR of 20% and teak of 15% (Stewart *et al*. 2020). Despite very promising financial potential, smallholder forestry commonly falls short of expected commercial returns. Other research by the project found that many smallholders who had planted teak in the 1970-80s had harvested their trees with disappointing financial returns, replanting with sengon or converting to agricultural enterprises (Permadi *et al*. 2020). As commonly reported around the world, smallholders often view trees as requiring little active management until harvest, whereby originally anticipated financial returns fail to be achieved. A large part of this disconnect between expectations and reality is the poor grasp of silviculture by smallholders. The MTG training shows that when smallholders are provided a farmer-centred approach, they can readily understand the principles of silviculture and the commercial drivers of value-chain transactions. The market-first approach taken by the MTG course is also meant to highlight the need for landholders to develop information links with industry and stay informed of market needs.

Commercial forestry may only involve financial negotiations and transactions every 5-10 years, so it is easy for most smallholders to lose focus and interest after establishing their trees. Hence, the project's Farmer-to-Farmer Mentoring (F2FM) trial provided a means of embedding and extending knowledge and skills within local farming communities – rather than being dependent upon distant agency staff for forestry expertise (Muktasam *et al*. 2020). By developing a 'spoke and hub' approach, the District or Provincial forestry agency, or even a capable non-government organisation (e.g., Trees4Trees), in a central location could provide on-going support and training to experienced and interested smallholders through F2F mentors as a low cost option to maintaining the knowledge and skills among smallholders investing in commercial forestry, with occasional MTG 'refresher' courses.

Despite the underlining philosophy of making the training courses farmer-centred and adaptable there is a risk that the MTG approach, and content, will be seen as a fixed 'recipe'. For example, there has been a strong tendency to run the MTG courses over 4-5 consecutive days on a full day timetable, often primarily for convenience and efficiency of facilitators and presenters. However, the project's research exploring barriers to women's active participation in MTG training courses suggest the hurdles were largely structural, in that few women were able to commit a full day to training activities located away from their home settlement (Harsoyo *et al*. 2020). Evidence from this work showed that when MTG training courses were adjusted to accommodate women (e.g., mid-morning start times, finishing mid-afternoon), then women were equally happy to participate alongside men to learn about small-scale forestry. There are elements of the processes and approaches used in these MTG re-design courses that appear to be important to improving their success:

1) the use of participatory processes in course development and implementation. The use of brainstorming techniques at the starting point of subject presentation reflect the ability of MTG course facilitators to learn from farmers' experiences, and show their appreciation to the local practices and knowledge. The way the MTG re-design courses were conducted in Gunungkidul where the courses were presented in 4 days, over two weeks, may reflect the participatory process being used to fit in with the local communities' needs and conditions.

2) the use of a market-first approach where the MTG re-design participants were facilitated to visit and learn from local timber processing industries. In Gunungkidul (Jepitu village), Bulukumba (Benjala and Malleleng villages), and Gorontalo (Rumbia village), the participants visited local timber processors/sawmills/vendors, while in Lampung (Budi Lestari Village), the participants were facilitated to visit plywood processor in South Lampung. Such visits were shown to be valuable learning experience for participants and useful in supporting ongoing networking with industry.

3) the courses not only addressed issues related to participants' lack of awareness and knowledge, unfavourable attitudes, perceptions, and aspirations, but also their skills and practices. At all MTG training sites, the facilitators engaged the participants in active practice themselves, both in class sessions and during field sessions.

4) the learning process takes place in the classroom, on farms and at timber processing industries. Participants learned from resource persons, through field observation and discussions, and by doing real things such as pruning and thinning, and measurement. Combining classical presentations, field observation and doing practical tasks is an ideal approach to farmers' learning.

5) courses are best conducted at the local or village level, close to the participants' houses or farms. Farmers prefer to stay close to their place and farms as they do have farming activities such as feeding their animals. When they are away from home and their business, there are risks that can disturb their learning concentration. Adult learning principles give a direction: '*Farmers learn well at their more comfortable places'*.

6) working closely with the local authorities and government agencies is likely to result in a course that is better supported and ensure improved follow-up support for participants. This was the case at Bulukumba, Gorontalo, and Lampung where the local teams worked together with local government (Bulukumba) and Forest Management Units or *KPH* (Gorontalo and Lampung).

7) the MTG courses conducted in Pati, Bulukumba, Gorontalo and Lampung were based on a 'Training Need Assessment' as it is suggested in the MTG re-design concept. In line with these strengths, this evaluation studied the feedback from the MTG course alumni and the key informants who strongly suggested keeping the existing process and approaches of the MTG course.

The Bulukumba Government has been the leading example for the adoption of the MTG approach for forestry extension. For many years, the local government budget and support has been allocated to helping tree growers improve their knowledge and skills in tree growing for commercial purposes. A national meeting to share and introduce the MTG approach to forestry extension staff was held at the Forestry Extension and Education meeting in Bogor on the 24 October 2018. A positive response from the extension personnel and agency was clearly identified in this meeting. The production of the MTG manual for facilitators and the manual for farmers was a parallel process to support this effort. Another challenge is to ensure the content of the course reflects local needs and opportunities. In Pati for example, the MTG training may have been improved

by including subjects on the development of NTFPs (such as honeybee cultivation). As a result of tree growers' behavioural changes, new economic opportunities may emerge that were unforeseen by stakeholders. By building a stronger awareness of the interests and needs of women interested in CBCF, the project team adapted several MTG courses better suited to women than previous courses (see Figure 3, below).

Figure 3: Participants in Master TreeGrower training courses, Indonesia (photos by project team)

Adopting a gender-sensitive approach saw approximately equal numbers of men and women undertake MTG training, and gave more women the confidence to share their experience with CBCF among their networks of family and friends (Harsoyo *et al*. 2019). The MTG training in 2014 was dominated by men in all three locations, but in 2018-19 there was a greater balance in participation by men (53%) and women (47%) (see Figure 4, below). The increase in the number of female participants was a result of interventions carried out in response to the FGDs, which identified that when women's practical gender needs are addressed, more women are likely to participate.

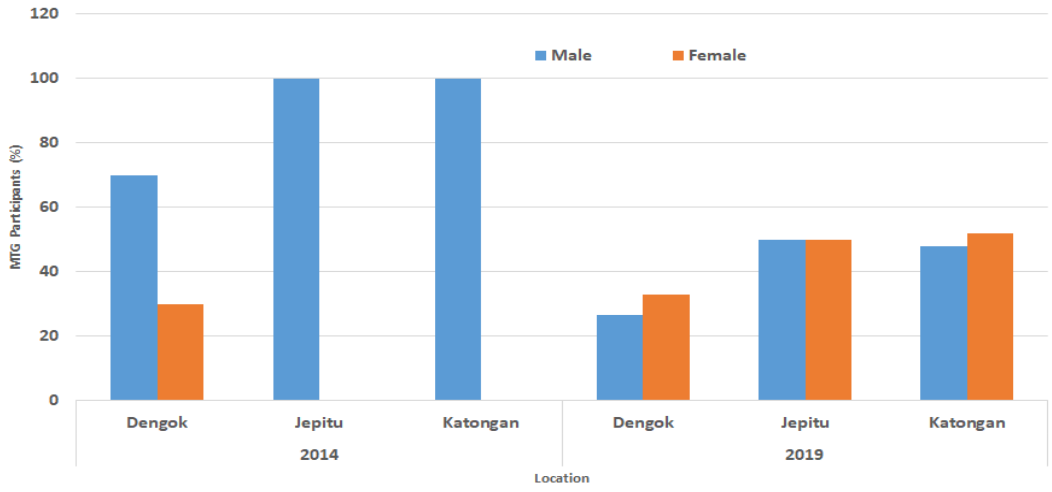

Figure 4: Male and female participants in the MTG training conducted in three villages in Gunungkidul in 2014 and 2019

The MTG training conducted in Gunungkidul has had a positive impact by increasing the forestry-related knowledge and skills of both men and women. Evaluation of the increase in knowledge was measured based on several topics, namely marketing, tree and log measurements, tree selection and seed quality, planting trees, pruning and thinning, harvesting, land utilization, and pest and disease management. Improved knowledge and skills were measured using scores between 1 and 5, starting from 'slightly improved' equating to a score of 1, to 'very much improved' equating to a score of 5.

Overall, the knowledge and skills of both men and women were improved after attending the MTG training at all villages. The effort to enhance smallholders' capacity through the MTG training courses was also appreciated by the private sector, as it is anticipated that the capacity building for smallholders will translate into producing timber of high quality and more likely to meet industry specifications (Suka *et a*l. 2020). A strategy for engaging the dominant private sector businesses in the timber value chain could vary from simply keeping the actors informed, to meeting their needs, and closely managing them. Engagement for each actor in each study location could be conducted differently, depending on their specific interests and business conditions. Even so, formulating a general strategy of engaging the dominant private sector businesses in project activities is also necessary to increase the strategy's potential for adoption in other locations with similar conditions. The study offered some alternative choices for the respondents in answering the question of *'How can the project assist you?'* The project's engagement consisted of the following actions:

1. **Involve the private sector in relevant project activities:**

   Involvement of private sector actors occurred throughout the project, such as during the project's data collection activities (e.g. interviews, FGDs, surveys), MTG training courses (e.g. visits to processors) and workshops (e.g. to analyse regulations).

2. **Contribute to the information needed by the private sector:**

   Some of the information needed by private sector businesses could be provided by the project, such as where to buy good quality seedlings, tree management, timber harvesting, and business financing.

3. **Keep the private sector informed:**

   The project team aimed to keep key private sector stakeholders informed about the project's activities, results and future events. While the project's newsletters were useful, many actors preferred attending meetings in person where topics could be better explained and understood.

Strengthening the social networks of smallholders is important for raising the general level of knowledge about CBCF and producing timber of higher value, and creating realistic expectations of what a fair price is for their produce among the local community. A cohesive local community also makes it easier for smallholders to assemble a 'critical mass' of produce to attract the interest of buyers who work for major processors, potentially offering greater financial returns for their trees. Investing in building the capacity of the local networks of smallholders and extending their links to those operating in the market place, is particularly important for remote rural communities who may otherwise have limited social networks.

Diversifying smallholders

The economic development of Indonesia is leading to greater urbanisation, whereby the majority of people live in urban areas. Even among smallholders who identify themselves

as ‘farmers’, many generate the majority of their household’s income from off-farm employment and enterprises (Race *et al*. 2019). The project’s Economic and Social Dimensions (ESD) household survey of representative families in study sites in Bulukumba, Gunungkidul and Pati (eight villages) recorded the composition of annual income in 2013, 2017 and 2020 (*n* = 240). The ESD survey revealed that across the sampled households, 56% of income was derived from off-farm sources (e.g. employed as labourers, small enterprises). Even in locations where agriculture is still the dominant source of household income, such as in Boalemo and South Lampung (Gorontalo and Lampung provinces respectively), an increasing proportion of income was derived from off-farm sources during 2018 and 2020 (*n* = 60) (Race *et al*. 2021). Agroforestry (the integration of trees with crops and/or livestock) comprised about 29% and commodity agricultural crops comprised 14% of household income (Race *et al*. 2021) (see Figure 5, below). Agroforestry was a prominent land-use for smallholders across ‘low’, ‘medium’ and ‘high’ wealth categories.

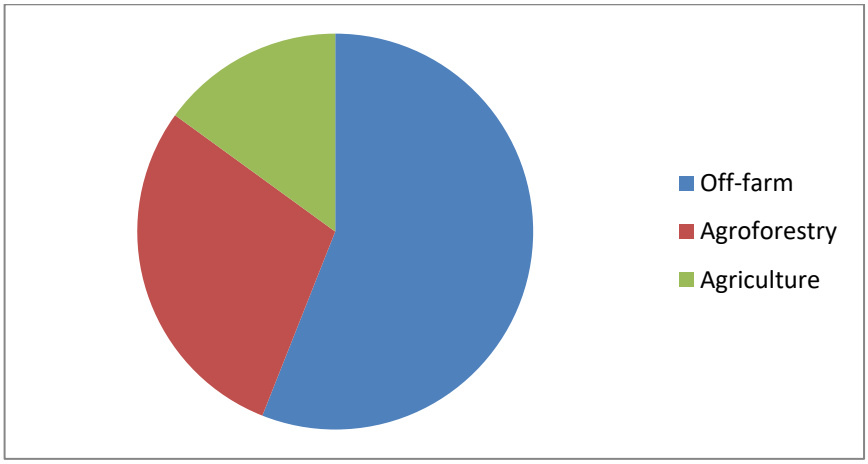

Figure 5: Composition of household income (data by project team, 2013, 2017 & 2020)

Where there are vibrant local markets for timber, growing trees for commercial products is an appealing option for a range of smallholders, as they can passively accrue wealth as their trees grow until the family chooses to make a large purchase (e.g. health care, school fees, large family celebrations) – with some people referring to their trees as a ‘living savings account’ (Irawanti *et al*. 2017).

The low capital investment and relatively little labour demand for tree growing, compared to other more intensive crops (e.g. coffee), make integrating a small number of sengon and teak trees into their farm an easy option. Even when adopting the recommended silviculture, smallholders can undertake much of the work themselves with existing farm equipment (e.g. hand saw) at convenient times.

Policy context

Government faces a myriad of challenges when seeking to optimise economic development across a highly diverse country and population. Achieving the desired outcomes from a national policy in any given situation is a complex task (Wibowo *et al*. 2013). Indonesia also has three tiers of government, making the implementation of consistent and effective policy a more challenging task. The President of Indonesia has re-committed to establishing 12.7 million ha of CBCF across Indonesia on degraded forest land owned by the State. While it is a well-intentioned and supported policy goal, the social forestry program has not always been able to achieve its annual target. A major challenge for policy makers is to ensure the policy pathway has the capacity and resources so the social forestry program is understood and effectively delivered in diverse

local settings (Wahyudiyati *et al*. 2019). For example, building the capacity of local agency staff, company and NGO staff, and local communities of smallholders so they can analyse and compare the relative value of CBCF compared to the alternate agricultural and development opportunities (Wibowo *et al*. 2019). Harmonising the process for efficiently implementing national programs across Indonesia's 34 provinces should not be underestimated, yet it is an essential prerequisite if the social forestry program is to achieve a viable model of CBCF across 12.7 million ha of degraded rural land. That is, the effectiveness of a national program still requires a supportive policy environment in all tiers of government, all the way down to the village regulations (*peraturan desa*).

Despite efforts to meet the policy target of 12.7 million ha under social forestry programs by July 2017, progress has been slow. This slow progress is partly due to different levels of government having different development priorities and sometimes competing interests between state agencies (Setyowati, 2017). If the current policies for social forestry only focus on establishing a nominated area of forest, then the outcomes will be merely administrative – considerable capacity building needs to occur at the site or village level so smallholders are informed, knowledgeable and skilled. There also needs to be institutional reform at the local level, so local government agencies and other actors (e.g. private sector, NGOs) are capably engaged in the social forestry process – design, implementation and long-term management – so the full array of benefits are achieved.

Optimising social forestry policies and accelerating the implementation of SF programs will not be easy. The very large scale of the program (at 12.7 million ha) does not necessarily mean it will lead to greater success. It would also be naïve to consider the SF policy reform successful when viewing it from the perspective of changes in the political space. Herawati *et al.* (2017) points out that in the next 10 years, there will be six major driving forces affecting the success of SF implementation. These include:

1) the dynamics of SF regulations including for forestry businesses;

2) economic options created by communities to improve livelihoods;

3) community ownership rights over forest resources;

4) budget support from local governments;

5) the human resource capacities of agencies such as the Provincial Forestry Service, FMU and NGOs; and

6) clarification of the roles of stakeholders including for raising public awareness.

Farmers in both Lampung and Gorontalo are rational farmers. They will cultivate only the most profitable commodities. Their preference is to grow maize or cassava rather than timber trees, because these two commodities have many advantages over wood production. Clear markets and larger profits with shorter waiting periods are key considerations. At this time, there is little field-based evidence or examples demonstrating that timber cultivation can be more profitable than the cultivation of maize and cassava in these two locations.

Timber commodity-related regulations in Indonesia are still complex, although there have been some improvements for timber production from social forestry programs. The complex regulations are particularly relevant to the industrial sector, where they can inhibit development such as if a business is seeking to increase its capacity of timber production. The burden of regulations can also deter business establishment. The transaction costs for timber industry businesses are also high. In contrast, similar businesses in China are supported by government in the form of subsidies also even the buyer of the timber product was given the ease of doing business. An absence of policies that encourage the integration of upstream and downstream processes has resulted in lower profits for farmers. Middlemen still play a key role in determining the price. More organizational units that are willing to buy at a higher price than the middlemen are needed. Access to capital

is a major limitation for these organizations and restricts their capacity to buy timber from farmers.

Community Plantation Forestry / HTR program

The project team's assessment of the HTR program found a range of factors impeding the program's successful implementation. Collaboration between governments and NGOs was identified as an important factor to progress HTR implementation. Also, stakeholders reported the need for capacity building for local farmers, local institutions (e.g. FFGs and cooperatives) and agency extension officers. Consideration of institutional and socio-economic factors along with personal characteristics of key stakeholders such as their beliefs, attitudes, financial resources and skills are important determinants of CBFM outcomes (Tole, 2010).

In Boalemo there has been much effort to develop the HTR program in the district, including interventions by the central government and local-level stakeholders. For example, the central government representative of the Technical Implementing Unit (TIU) in Gorontalo provided seedlings to farmers through the local FFG, with the expectation that the farmers would grow the timber trees in the designated HTR area. But the head of the FFG had limited knowledge of the HTR program and limited capacity to implement it, and as a result the seedlings were planted on private land without any oversight from the TIU. This demonstrates a need to improve the capacity of FFGs because these local-level institutions are a key stakeholder in the development and management of profitable HTR projects (Rohadi *et al*. 2016). In addition, TIU staff also need to be encouraged for improvement in terms of their motivation in monitoring and evaluation at the field level, as well as the development of more accurate reporting on the progress of projects.

The research has also highlighted the importance of strong leadership of the local FFGs and cooperatives. The Gedong Wani FMU in Lampung was found to be facing similar challenges for HTR implementation as in Boalemo. The limited understanding of HTR programs among the FFGs was also evident here, with one FFG member believing their participation in the HTR program meant they were entitled to a land certificate from the government. Historically, the farmer and other members of the FFG were residing illegally in the HTR forest area, and with the issuance of HTR permit, they incorrectly believed that they had been granted the legal right to reside in the HTR area. The FFGs need guidance on both the technical and business management aspects of HTR to develop their knowledge of HTR policy, potential timber markets and silviculture, to help them access capital, and ultimately to manage HTR plantations for profit.

There is still a very limited understanding of HTR in the Budi Lestari community. For this reason, the extension officer has mostly focused on introducing and explaining the HTR concept. The low capacity of local farmers is also a hindrance to successful HTR implementation. The FFG leaders played a meaningful role in motivating members to plant timber in the HTR area. Therefore, FFG leadership is a key factor in the successful implementation and ongoing management of HTR programs. The FFGs (and the leadership in particular) therefore require greater support from the local and provincial governments. Specifically for the permit granting process, it needs to raise community awareness and understanding of HTR programs and their potential to benefit local communities (Febriani, *et al*. 2012).

While the social forestry program has been initiated by the government, its success will largely be determined by whether millions of smallholders can develop CBCF into a profitable enterprise that is supported by a competitive network of local and provincial processors and manufacturers. The project's financial analysis of sengon and teak gives an indication that integrated CBCF on a large scale is feasible, at least in Central Java where the data was derived (Stewart *et al*. 2020).

Results of the policy lab

The ‘policy lab’ workshops revealed that the field assistance given to smallholder forestry also needs to be available for ‘upstream’ and ‘downstream’ actors in the value-chains utilised by farmers sector – from tree planting, silviculture, harvesting, processing and manufacturing. The role of NGOs in the success of smallholder forestry is also important as they often provide assistance during administrative process and field implementation.

The policy labs also revealed that building entrepreneurship in farmer groups is not easy, such as how to identify and measure risks, and prepare contingency plans. Also, increasing the range of ideas and possibilities for CBCF would also be valuable, particularly to develop new markets. For example, in Kalibiru (Yogyakarta), the development of eco-tourism in the community forest provides additional income of about IDR 100 million per month for the community. However, most stakeholders don’t have a strong understanding of the policy and regulatory context affecting CBCF.

Clear foresight

Indonesia’s economy is dynamic and expanding, but like any other country, it is not isolated from global economic shocks and challenges (e.g. the global recession in 2020 caused by the covid-19 pandemic). Looking ahead to what the context might be like for smallholder forestry, say in 2030, was an important activity undertaken by the project team. The foresight process involved a strategic analysis of the potential major influences on smallholder forestry in Indonesia in 2030, identifying key influences and markets for smallholders (Robins and Kanowski 2019). Different people interviewed expressed views that reflected their role and responsibility. For example, smallholders focused on likely ways to improve their family’s wellbeing (which may not involve tree growing), company staff focused on ways to encourage smallholders to grow more wood, provincial agency staff focused on ways forestry could support regional development, and national policy makers focused on ways to incentivise smallholders to establish and manage large areas of forests.

The overall demand for timber is anticipated to increase, but this demand may not necessarily translate into profitable opportunities for smallholders, if much of the demand is for low-value fibre grown and processed on a large-scale. Growing trees for local and provincial markets in the major centres of economic development with short value-chains, together with small niche markets (e.g. construction of *phinisi* boats, certified furniture), are likely to be the best opportunities for smallholders (see Figure 6, below).

Figure 6: Construction of *phinisi* boats relies heavily on the supply of timber from smallholder forests

Overall, the multi-staged methodology employed for this foresight analysis of the prospects for smallholder forestry in Indonesia was effective. The three key stages included:

1. a review of international literature and other credible publications prepared by government and the private sector;
2. in-depth interviews with 26 stakeholders with deep experience, drawn from government, non-government organisations, private sector, academics and farmers; and
3. three interactive workshops with facilitated discussion among 34 participants.

However, important lessons emerged from the foresight methodology, including:

- the context, scale and timeline are important to define, otherwise discussion tended to be dominated by the local context (issues and opportunities) and short-term objectives;
- a range of stakeholders did not express a singular or shared vision of the likely future, or what's desirable – there are multiple narratives about CBCF;
- there wasn't a shared view of the key constraints and opportunities, making it challenging to galvanise support around a single policy, program and strategy for implementation;
- it is hard for stakeholders who are focused on the 'daily realities' to think about the 'unthinkable' of a distant time point (the project team needed 'foresight' expertise, methods and training);
- reviewing the dominant literature and interviewing easily identifiable stakeholders can merely entrench and perpetuate the *status quo* paradigm; and
- innovative pathways may need some 'disruptive' literature and people to inform the foresight process – deliberate 'futures' methodology.

What does the future hold?

The information obtained generated a comprehensive and diverse picture of the future of smallholder forestry in Indonesia, with a notional timeline of 2030. Indeed, the foresight analysis revealed multiple narratives of smallholder forestry in Indonesia, with important contextual differences depending on whether it is located 'within Java' or 'outside Java', and focused on global or local markets. There was also a marked difference depending on whether a person's experience and role was to source timber to supply private processors (private sector), provide incentives to grow trees and expand forest cover (government), or seeking to enhance farmers' incomes and livelihoods (grower). Another key difference in views is whether the stakeholder is engaged in establishing and expanding forests at scale, or seeking to develop opportunities for smallholders to integrate forestry into their portfolio of enterprises because forestry is a viable investment. Large-scale forestry tends not to appeal to smallholders, who typically prefer to manage small parcels of land (<2 ha) relatively intensively with multiple crops – growing trees being just one option for commercial sale or household use.

The foresight analysis revealed that among a range of stakeholders with deep experience of forestry policies, programs and practices, there is not a shared or singular view about the opportunities for smallholder forestry in Indonesia, nor how it should be developed. Part of the challenge of seeking a singular view of smallholder forestry is that Indonesia is such a diverse country – demographically and economically. While broad national goals and supporting policy instruments are likely to be achievable, implementing specific programs need to be cognisant of the local context and opportunities – particularly the market dynamics that may favour smallholder forestry, or otherwise. Working strategically at the sub-Provincial or District level may be the most effective scale to coalesce stakeholders around a development agenda framed by the local context, whereby smallholders can easily detect the market signals, the value-chains are evident and trusted, processors can forecast likely supplies, non-government organisations can provide the 'voice' and influence of civil society, and government can practically provide the regulatory oversight and program support – an integrated and productive 'hub' for sustainable smallholder forestry.

Indonesia is at a point in time where smallholder forestry, with the right incentives and support, could prosper as an integrated and sustainable enterprise practised by most smallholders – at least in much of Java. Alternatively, with ad hoc or uncoordinated support and mixed messages from government and the private sector, smallholder forestry may follow opportunistic waves of 'boom and bust' and most stakeholders are sceptical of its long-term value. These two divergent paths are summarised in Table 4, below.

Table 4: Two pathways for smallholder forestry development in Indonesia

Reactivate & uncoordinated pathway (undesirable)	**Proactive & strategic pathway** (desirable)
Smallholders: • grow trees & sell opportunistically; • unaware of silvicultural options & produce low-value mixed products (minimal input); • unaware of the commercial value of forest products & specifications; • unaware of market dynamics (why prices fluctuate, trade regulations, certification); • sell forest products individually to nearest buyer (local 'middleman'); and • unaware of support from, or value of, FFG.	Smallholders: • grow trees &/or NTFPs as a strategic investment – integrated with farming business; • understand a range of silvicultural options – and choose best approach for them; • aware of the commercial value of forest products & specifications; • aware of market dynamics & optimum process to sell forest products; • aware of options to negotiate & sell forest products; and • are active members of local FFG.

Making CBCF work for all stakeholders

1. The economic dynamics that directly influence the profitability of smallholder forestry mostly operate at the local and provincial levels. Creating vibrant business 'hubs' for CBCF at these levels, where there are multiple value-chains for the range of timber products grown by smallholders (e.g. low- to high-grade timber) that can be affordably accessed, will be vital.
2. These 'hubs' should provide support to increase the knowledge and skills of smallholders and field staff, such as the farmer-centred MTG training courses that start by taking growers to the marketplace – a 'market-first' approach. Raising the knowledge and skills about smallholder forestry will flow on to the future timber supply desired by markets.
3. The government agencies need to be well-connected and streamlined for efficient administration, coordination of support activities and effective regulatory oversight of the timber value-chain, from growing to harvesting, transporting, processing and manufacturing, and export or retail.
4. Introducing timber 'standards' (product specifications and prices) that are widely accepted and understood will also help consolidate the value-chain as each actor is better informed about the quality and prices of the product as it moves along the value-chain.
5. Ensuring CBCF is a profitable enterprise for smallholders will motivate them to replant their harvested trees, and encourage their farming neighbours to also invest in CBCF. If this process is replicated at scale, we could see CBCF drive reforestation across Indonesia and achieve the President's ambition of having 12.7 million ha of degraded rural land dedicated to productive and sustainable forestry.

6. While most of the project's research focused on timber, CBCF also includes a range of non-timber forest products (e.g. bark, medicinal herbs, fruit and seeds) and increasingly, novel markets for environmental services (e.g. carbon sequestration, biodiversity). Expanding the focus of CBCF beyond timber will open new markets and appeal to a wider range of potential investors – smallholders, small and large businesses, government and private organisations, domestic and global markets. An exciting era for CBCF awaits!

Further information

A summary of some of the project's key findings have been published in an article in the science magazine – *Research Features* (July 2021), with a copy attached as Appendix 3. For further information about this project or individual research reports or articles, please visit the project's website managed by Indonesia's Ministry of Environment and Forestry's FOERDIA at: www.puspijak.org/cbcfindonesia

8 Impacts

8.1 Scientific impacts – now and in 5 years

The project's scientific impacts are viewed as the short-term influence the project team generates within the professional and social spheres in which the team operates. For example, the key findings, results, discussion and conclusions from all the components of the project have been shared frequently and widely by individual project members, most notably in the last 2.5 years of the project when most of the empirical research was completed, analysed, documented and shared – within individual organisations (partner organisations) and at large stakeholder events (e.g. national conferences). Personal communication and presentations of the project's science tends to have a more immediate impact (influence) when shared with peers who can critique and scrutinise the quality and relevance of the research findings and conclusions in 'real time'. One strategy that appeared effective in terms of influencing policy makers was to publish a policy brief and then convene a 'policy lab' with 12-15 senior policy makers and program managers in Jakarta to discuss the project's results in relation to specific policies and programs (discussed in more detail in the project report by Aneka Prawesti Suka *et al*. 2021).

The project team has also endeavoured to capture the key elements of the project's science in 10 articles published in peer-reviewed international journals (listed below). The project team believes that the articles in international journals will provide a more enduring impact (influence) from the project, particularly when articles become available in Open Access (often > 2 years), and far beyond the geographic scope of the project (i.e. Indonesia).

8.2 Capacity impacts – now and in 5 years

The project team engages a wide range of partners and stakeholders to enhance the policies and practices related to improving community-based commercial forestry. The project team is aware of the need to work with practitioners (e.g. farmers, field staff) and policy-makers. Policy-makers, program managers and district officers are responsible for designing, interpreting and overseeing support programs and regulations. The 'policy lab' discussions with policy-makers and distribution of policy briefs are key ways the project sought to have a positive influence on the policy environment of CBCF. An example of the project's five policy briefs include:

'Revitalising Community Forestry', by Lukas Rumboko Wibowo *et al.*, FOERDIA Policy Brief 14 (4) 2020 (written in *bahasa Indonesia*), which identified there was often a disconnect between national policies and programs (e.g. the HTR program) and district-level implementation, partly explained by:

- the uncertainty in how district agencies and local organisations should interpret broad national guidelines in the local context; and
- the capacity and expertise in many rural communities is not at a level where detailed and rigorous site assessments and market analyses can be complemented in order to access funds available at the national level.

'Timber Legality Verification System' (*SVLK*), by Dede Rohadi et al., FOERDIA Policy Brief 14 (7) 2020 (written in *bahasa Indonesia*), which identified that to increase adoption of the SVLK certification by timber producers and small-scale timber industry in Indonesia, the government still needs to:

- facilitate training and accreditation of a large number of SVLK auditors so that there are an adequate number of auditors available locally to timber industry locations;

- encourage the use of certified timber for government infrastructure projects;
- strengthen the direct and strategic connectivity between farmers seeking to grow trees and the timber industry; and
- simplify the regulations and shorthen the timeline for the licensing process.

Several research reports by the project team and numerous other analysts have identified the need to enhance the capacity of farmers – their practical knowledge and skills in silviculture as well as their business acumen – if CBCF is to become a widespread, profitable, and sustainable component of rural livelihoods and local industries. The project's development of the MTG training program offers insights about how such training can be adapted and scaled-out across Indonesia and elsewhere (see project report by Muktasam, Rowan Reid *et al*. 2021). District agencies have an allocated budget and most villages are granted funds from government for development activities, both which could be sources of funding to support local MTG training courses. Encouraging District and community leaders to prioritise support for further MTG training is an important strategy for the project team and partners to pursue over the next 12 months. The growing number of alumni of the MTG training program could also be promoted as supporters of community-based forestry (e.g. mentors) to complement the government's existing network of extension officers that remain limited in capacity and number.

The project team understands the importance of effective business networks if smallholders are to receive fair prices in the market place; however, often farmers have limited business networks and sell their forest products to local traders for modest returns. An effective value-chain for all actors involved relies on having credible, current and relevant information about forest products, market specifications, and demand and supply – in local and global markets. Informing farmers about how market dynamics work (e.g. pricing, demand and supply), and informing traders and processors about what is required for growing high-quality forest products (e.g. matching species to sites, growth rates, silvicultural options), is leading to better informed stakeholders and greater cooperation. The project team's experience is documented in a report about how farmers can forge stronger links with the private sector (see project report by Aneka Prawesti Suka *et al.* 2021).

8.3 Community impacts – now and in 5 years

The role of women in CBCF in Indonesia and elsewhere is often overlooked and understated. The project aimed to better understand the role of farming women in CBCF in Indonesia and sought to better engage them in the MTG training courses. Led by Harsoyo (UGM Yogyakarta), the project explored the reasons why so few women typically participated in the MTG training courses in Indonesia, and then re-configured three MTG training courses to test the project's strategies to increase women's participation (see project report by Harsoyo *et al*. 2020). Key findings from this research activity included:

- adopting a gender-sensitive approach to training women farmers can be effective (e.g. ensure training locations and times suit women); and
- engaging experienced and trusted women to promote the benefits of the training to other women in a village.

When the project team incorporated a gender-sensitive approach, the number and proportion of women successfully completing the MTG training in the same villages greatly increased.

The project also finalised its evaluation of the Farmer-to-Farmer Mentoring (F2FM) trial, which aimed to test the concept of peer support in community forestry in Indonesia. The trial selected a small number of MTG participants from three of the project sites, namely the districts of Gunungkidul (Yogyakarta), Pati (Central Java) and Bulukumba (South Sulawesi), and provided them with training in mentoring techniques and support for

undertaking a mentoring trial (see project report by Muktasam *et al*. 2020). Some of the key findings included:

- when farmers are confident with new knowledge, practices and skills, they are generally enthusiastic to share their experience with their village neighbours;
- farmer mentors are usually effective if they have in-depth personal experience of the activity they are discussing, own (manage) land within the same village, are willing to share their failures and successes (i.e. lessons), understand the purpose and role of being a mentor (i.e. not a teacher), and are a good communicator; and
- if mentors are well supported in their role, they can be effective at scaling-out practical and positive experiences about CBCF at the village level, in an efficient and responsive manner.

8.3.1 Economic impacts

The project team has conducted the third and final stage of the Economic and Social Dimensions (ESD) household survey during January to March 2020. The results from the ESD survey are presented in the project report by Digby Race *et al.* (2021) and the key findings and conclusions will be published in an international journal later this year (see article listed as: Race *et al.* (2021). Modern smallholders: Understanding the diverse livelihoods of Indonesia's farmers. *Small-scale Forestry*, revised and re-submitted).

Detailed analysis of two popular tree species planted by farmers in Pati and elsewhere in Indonesia – sengon (*Paraserianthes falcataria*) and teak (*Tectona grandis*), was completed by Hugh Stewart and colleagues (see project report by Hugh Stewart *et al*., 2020). Teak is the most important timber species in Indonesia with most teak sold to domestic markets primarily for furniture manufacture; sengon produces timber that is highly suitable for veneer and plywood production and is a species that smallholders have cultivated in agroforestry systems in Central Java for generations. Much of the analysis is built upon the extensive network of field trials (measurement plots) managed by Trees4Trees staff with their partner farmers. Some key findings of the analysis included:

- a smallholder sengon plantation modelled on a 6-year rotation was a profitable enterprise with an estimated NPV of Rp 14,218,000 ha^{-1} at a real discount rate of 8% and an IRR of 20%;
- a smallholder teak plantation modelled on a 20-year rotation was also a profitable enterprise with an estimated NPV of Rp 39,408,000 ha^{-1} at a real discount rate of 8%, and an IRR of 15%; and
- household labour, a primary asset of family farms, used in smallholder forestry could generate over the long term, earnings that would be competitive with agricultural work and with external employment options.

Detail financial analysis indicated that both species could be highly profitable enterprises for smallholders, although typical approaches to silviculture would need to improve. The results support the widespread view that the greatest opportunity for enhancing smallholder returns from forestry lies in remedying poor silviculture, particularly the lack of effective pruning and thinning, to realise the potential of timber production under management systems informed by contemporary technical knowledge of plantation timber production.

8.3.2 Social impacts

Details about the positive social impacts generated by the MTG training and the F2FM trial program are discussed in detail in project reports and published articles. Also, the project's newsletters document case studies about the positive impacts above. Two examples of the project's social impacts include:

- in Boalemo district (Gorontalo), the MTG training had broadened and strengthened farmers' understanding about the land management and economic opportunities

from CBCF. The farmers are now more confident in seeking support from partners to make CBCF more viable, such as writing applications to government requesting genetically superior seedlings and accessing the 'delayed harvest' fund (*BLU*); and

- engaging women in training should begin with gender-responsive planning, which considers aspirations and needs of women and obstacles they face. In Gunungkidul (Yogyakarta), an assessment of women's interest and training needs found that more farming women were interested in learning about CBCF than previously thought. When the project team used a 'gender-sensitive' approach to designing and implementing the MTG training courses in the district, 63% of participants were women (previously <15% of participants in MTG training were women in the same district).

The project held an Australian Study Tour (15th – 22nd September 2019) which gave 11 participants (farmers, local partners and agency staff) a deeper understanding of how the MTG training program is designed and delivered in Victoria, with participants hearing from presenters and participating farmers. The study tour also gave participants a broader understanding of the purpose and support for a farmer-to-farmer mentoring program (the Otway Peer Mentoring program) and how it complements the extension programs delivered by agencies and NGOs. The participants on the study tour reported that the experience and knowledge they gained will give them confidence to adapt and expand the nascent MTG and F2FM programs in Indonesia (see project report by Muktasam *et al*. 2020).

8.3.3 Environmental impacts

The project's focus was on planted forests, typically on privately owned farmland and cleared State land. Over time, it is anticipated that the project's research will assist to incentivise further establishment of trees on farmland, providing a positive environmental impact. Evaluation of the recent MTG training completed by participants indicates that when smallholders are confident that they understand the silviculture and market opportunities, they tend to increase their investment in CBCF. The increased investment is comprised of planting additional areas of farmland with trees and/or improving the silvicultural management of existing trees.

The project team has also explored the extent to which 'environmental' certification of smallholder forestry would lead to greater investment in sustainable forest management in Indonesia. The two main forestry certification schemes operating in Indonesia are the globally recognised Forest Stewardship Council's (FSC) and the domestic (Indonesian) SVLK scheme. The project's research found that the SVLK certification scheme generally provided a good 'entry point' for Indonesian timber products that aim for export, especially with the SVLK ratification by the European Union. Also, the S-LK exemptions that have been granted to smallholder private forestry through the use of DKP (supplier conformity declaration) has increased access to export markets for their timber. Meanwhile, the FSC certification scheme still maintains its market segments, especially to meet the demand for certified timber by some multinational furniture companies.

However, the project team concluded that the costs and benefits of certification are likely to remain a challenge for timber certification in Indonesia, at least in the short to medium-term. Termination of certification was often due to processors being unwilling to pay the cost of the extra administration, auditing and assessment, especially for smallholders who generally obtained their first certification through government or donor supports. The use of the existing certification schemes may occur when the tangible economic benefits outweigh the certification costs (see project report by Dede Rohadi *et al*. 2019). As such, timber certification is considered to have made a modest environmental impact across the agricultural and forestry sectors in Indonesia at this point.

8.4 Communication and dissemination activities

Ms Aneka Prawesti Suka (FOERDIA Bogor) oversees the project's 'communication' plan, which listed the different stakeholder groups and how best the project can communicate with them (see project report by Aneka Prawesti Suka *et al*. 2021). The project's communication plan was reviewed and updated every six months.

Social media

Mr Bugi Sumirat (FOERDIA Bogor) managed the project's communication via social media (*Facebook, Instagram, Twitter, Youtube*), which has increased the reach and interest in the project's activities and publications. For example, over the last 12 months the project's *Instagram* site had 465 followers with a total of 108 'impressions' (the project averages nine posts per month on *Instagram*). Further analysis of the project's *Instagram* site indicates that the top five cities for 'impressions' were Makassar, Bogor, Jakarta, Palangkaraya and Yogyakarta. The project's *Facebook* site also has an expanding reach, with the project now having 391 followers. The most popular posts include 'action' photos and short videos, with an average visitation of 240 views per month.

Project newsletters

The project produced nine editions of a bi-lingual newsletter about every six months for wide dissemination – electronically and hardcopy, that documented the project's recent findings, activities, publications, and case studies. The project printed 500 hardcopies of each newsletter that were mainly distributed to the project team and partners at the five study locations, with the remaining copies then distributed at conferences, seminars and workshops conducted by FOERDIA.

Policy briefs

The project team considered that communicating research results to policy makers would be easier if written in a short paper instead of relying on them to read journal articles or full project reports. The policy briefs published by the project team were largely written in *bahasa Indonesia* and followed the guidelines prescribed by FOERDIA, Bogor. Each policy brief had 300 hardcopies printed, with a similar distribution strategy of the hardcopies and PDF files as for the project newsletters. In addition, through the Director General of FOERDIA, the project's policy briefs were shared with the Minister of MoEF, together with other policy briefs published by FOERDIA, Bogor.

9 Conclusions and recommendations

9.1 Conclusions

While the broad aim of the project was to inform how we develop CBCF across Indonesia, the country is so diverse that the opportunities for CBCF vary widely. The conclusions discussed below reflect the project's study sites, but are also thought to be relevant to many other parts of Indonesia.

There is strong demand for a range of timber products (e.g. sawn boards, veneer, furniture and appearance timber) throughout Java and in major centres of urbanisation (economic development) – mainly growing population cities of >500,000 people (Indonesia has 27 cities with >500,000 people), mostly in Java, Bali and Sumatra. In rural areas that are remote from centres of economic development, commercial timber production is often not very profitable for smallholders compared to commodity (e.g. cassava, rice) and cash (e.g. coffee, rubber) crops.

Smallholders typically view CBCF as a passive enterprise, with little effort given to pruning or thinning trees as a forest grows. However, with appropriate silviculture at key stages of a tree's growth, CBCF could be a much more profitable enterprise for smallholders. For example, analysis shows that a small forest of sengon (*Paraserianthes falcataria*) could generate an internal rate of return (IRR) of 20% and a small forest of teak (*Tectona grandis*) could generate an IRR of 15%, if well managed. Smallholders understand the concept of how their management of crops and livestock affects the market price they receive, yet they do not commonly apply this concept to timber production. Certification that timber has been produced legally and sustainably has become an increasing requirement for international trade (e.g. FSC certification); however the project team found this has generally not led to more profitable smallholder forestry, as it has not led to expanded or new markets, and the cost of the certification process is usually not recovered through an increase in the price of logs from certified forests.

The project team has adapted the Master TreeGrower (MTG) training course to the Indonesian context and have delivered 21 courses since 2014. Together with the previous project (FST/2008/030), over 400 smallholders have undertaken the MTG's innovative training, which has a focus on growers' understanding the local market place, tree management and measurement, and how silviculture links to prices. Strengthening the social networks of smallholders is important for raising the general level of knowledge about CBCF and producing timber of higher value, and creating realistic expectations of what a fair price is for their produce among the local community. A cohesive local community also makes it easier for smallholders to assemble a 'critical mass' of forest produce to attract the interest of buyers who work for major processors, potentially offering greater financial returns for their trees.

The economic development of Indonesia is leading to greater urbanisation, whereby the majority of people live in urban areas. Even among smallholders who identify themselves as 'farmers', many generate the majority of their household's income from off-farm employment and enterprises. The low capital investment and relatively little labour demand for tree growing, compared to other more intensive crops (e.g. coffee), make integrating a small number of sengon and teak trees into their farm an easy option.

Government faces a myriad of challenges when seeking to optimise economic development across a highly diverse country and population. Achieving the desired outcomes from a national policy in any given situation is a complex task. Indonesia also has multiple tiers of government, making the implementation of consistent and effective policy a more challenging task. While it is a well-intentioned and supported policy goal, the HTR program has not been able to achieve its annual targets. A major challenge for policy

makers is to equip the policy pathway with the capacity and resources so the HTR program can be clearly understood and effectively delivered in diverse local settings.

Indonesia's economy is dynamic and expanding, but like any other country, it is not isolated from global economic shocks and challenges (e.g. the global recession in 2020 caused by the covid-19 pandemic). The overall demand for timber is anticipated to increase, but this demand may not necessarily translate into profitable opportunities for smallholders, if much of the demand is for low-value fibre grown and processed on a large-scale. Growing trees for local and provincial markets in the major centres of economic development, together with small niche markets (e.g. construction of *phinisi* boats, certified furniture), are likely to be the best opportunities for smallholders.

While most of the project team's research focused on timber, CBCF also includes a range of non-timber forest products (e.g. bark, medicinal herbs, fruit and seeds) and increasingly, novel markets for environmental services (e.g. carbon sequestration, biodiversity). Expanding the focus of CBCF beyond timber production will open new markets and appeal to a wider range of potential investors – smallholders, small and large businesses, government and private organisations, domestic and global markets. Potentially, an exciting era for CBCF lies ahead.

9.2 Recommendations

While the broad context for CBCF in Indonesia is generally positive, its 'success' for smallholders, rural communities, industry and government will largely be determined at the sub-national level (e.g. District and Provincial levels). The market opportunities vary markedly across Indonesia, particularly on Java compared to the outer islands, and between regions surrounding economic hubs (i.e. population centres of >500,000 people) and remote areas. Smallholders are generally astute at detecting price 'signals' for CBCF and tend to be agile entrepreneurs – readily changing crops or land-use systems if they feel a profitable enterprise can reliably be developed. Our research has found smallholders readily establish short-rotation timber trees (e.g. sengon) if there is commercial demand from local markets. Policy instruments (e.g. support via the HTR program) can help to magnify the opportunities presented by CBCF, however in countries such as Indonesia and Australia, appreciation of the underlying market potential must be clearly understood by all stakeholders investing along the value-chain encompassed by CBCF.

It is recommended that further analysis and documentation of the heterogeneity of opportunities (and limitations) for CBCF across Indonesia would be highly valuable for all stakeholders, but especially government, industry and smallholders. This analysis could inform national programs so these can be tailored to suit individual provinces so that the support addresses the specific constraints and limitations facing smallholders. For example, in some provinces the main constraints may be infrastructure, while in other provinces it may be low timber prices.

Also, it is recommended that national programs (e.g. the HTR program) work collaboratively with District and Provincial agencies to design an expanded and well-resource CBCF extension network – with government and NGO staff, and leading smallholders.

Lastly, the ESD household survey should be continued, perhaps every 3-5 years, to keep tracking the changing livelihoods of smallholders and the contribution to household income of commercial forestry. Longitudinal data will help to inform national and provincial programs about how best to initiate and refine programs and other support for CBCF.

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10.2 List of publications produced by project

Articles by project team members published in international journals

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11 Appendixes

11.1 Appendix 1:

Policy brief – *Summary of key findings*, May 2021 (attached).

11.2 Appendix 2:

Project's Monitoring and Evaluation rubric, July 2021 (attached).

11.3 Appendix 3:

'Can money grow on trees?' article published in the science magazine – *Research Features*, July 2021 (attached).