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Australian Centre for International Agricultural Research

Final report

Project full title

Vietnamese Native Tree Species for Improved Livelihoods

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Contents

1 Acknowledgments

We thank the staff of all our supporting organizations: the Vietnamese Academy of Forest Sciences, Tay Bac University, Muong La Nature Reserve, and Southern Cross University. We especially acknowledge the enthusiasm and interest shown by local communities, officials as well as farmers and villagers working in nurseries and on the land.

2 Executive summary

As with many tropical countries, Vietnam has experienced large-scale deforestation in the last century. It also has a wealth of little-known tree native species that could be incorporated into agroforestry systems such that human livelihoods can be enhanced and native biodiversity can be preserved. Northwest Vietnam is a largely mountainous region where growing annual crops, such as maize, is neither highly profitable nor sustainable for farmers, nor beneficial for erodible soils and degraded catchments.

The aims of this project were to encourage the use of high-value native species through developing community nurseries, a greenhouse and an understory planting activity at the headquarters of the new Muong La Nature Reserve. Staff from the Reserve, the Vietnamese Academy of Forest Science, Tay Bac University, and Southern Cross University evaluated market and economic potential for farmers' cooperative native seedling production, developed farmer-appropriate production of native fruit and timber seedlings, and generated preliminary silvics knowledge of selected timber species through experimentation.

Hundreds of seedlings of half a dozen native species were germinated, grown and used in experiments to determine growth rates and preferred light levels. Some of those same species were grown, along with highly valued fruit trees, at two local community nurseries, one of a Thai group and the other Hmong. They developed nursery skills in seed collecting and handling, seedling production and fruit tree grafting.

Through this project, and continuing efforts, native forest trees as well as commercial species such as cinnamon, are becoming part of the landscape.

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3 Background

Around the world, tropical forests are being decimated. Often areas of rainforest are replaced with grazing or agricultural fields. Occasionally, tree plantations are established, mostly single-species plantings of "exotics": pines, eucalypts, teak or acacias (Nichols and Vanclay, 2012). There is a great potential to investigate the biology and ecological niches of native tree species, collect propagules, and plant them out, either in forestry or agroforestry systems. This can be beneficial both in mitigating rapid biodiversity loss, in at least partially restoring forest ecosystems, and to smallholders on the land looking to diversify their livelihoods.

The Vietnamese forest industry is undergoing major change. Native forest harvesting was banned in 2014 (Decision No. 2242/ QD-TTg 2014), along with the export of raw logs. Meanwhile, Vietnam's timber processing industry has grown to become the world's fifth largest (Das 2018). These factors, alongside government's directives, have amplified demand for domestically sourced, high-value timbers. Vietnamese Government forest industry directives have increasingly emphasised environmental values of forests and the need to use scientific research to guide forest management (Decision No 78/2008/QĐ-BNN and Decision 886/QD-TTg).

Vietnam is noted for its contemporary increase in forest cover (Meyfroidt and Lamb 2008), although most of the increase has been exotic monoculture plantations, including more than 2 million ha of *Acacia* - mostly owned by smallholders (ACIAR 2020). The uptake of *Acacia* plantations has been less in mountainous northwestern Vietnam compared with in the lowlands because upland growth rates are lower and transport costs are higher (Kien and Harwood 2017). *Acacia* plantations are not financially viable away from the coastal zone; their main product is wood chips, which are transported by sea.

Some 30,000 m^3 of wood is processed annually in local sawmills in the three northwestern provinces of Son La, Dien Bien and Lai Chau (Kien and Harwood 2017), most of which is imported native timber from Laos and Cambodia. Large amounts of firewood are consumed in the region (Kim et al. 2016). This project has been an opportunity to lay foundations to produce some of this timber locally.

Given that farmers on the land in the northwest of Vietnam tend to have options that are not optimal in terms of making a living AND that the rich ecosystems of the region are disappearing rapidly, there is an urgent need to design viable sustainable land uses. This project made a start.

4 Objectives

Objective 1 Evaluate market and economic potential for farmers' cooperative native seedling production.

Tay Bac University Business School surveyed forest nursery/seedling suppliers at 10 km, 25 km, 50 km and sampled at 100 km distances from the MLNR to understand the existing supply. At the same distances, they assessed buyers and potential buyers of fruit, fuel and timber seedlings. In each case, they collected sale and purchase price information. A walk-the-chain analysis was conducted to understand current distribution networks for tree seedlings. From this foundation, VAFS will consult with larger timber industry to understand scale effects—how many seedlings would MLNR nursery need to produce at what cost to be attractive to industry buyers?

The nursery enterprise was trained to keep records of input costs (materials, water, labour) and production over time as a basis for business planning.

Objective 2 is to develop farmer-appropriate production of native fruit and timber seedlings.

Phenology transects will be established at MLNR along which mature individuals of desired timber (sawtimber and fuelwood) species will be marked and monitored for flowering and fruiting. Voucher specimens will be lodged with VAFS. These transects will be maintained as germplasm sources and the initial basis for tree improvement.

Seed maturation, germination rates and percentages and handling procedures (i.e., soaking, stratifying, scarifying) will be tested in the nursery in the open and under shade cloth. Germination in trays and pricking out will be compared with direct sowing into polybags. The goal is to develop routine handling procedures for the desired timber species.

Handling procedures for fruit tree species have been defined under FST 2016 152. The nursery will initially be subsidised by the project (start-up costs and materials) but should be selling seedlings within the year and transitioned to self-supporting.

Objective 3 is to generate silvics knowledge of selected timber species through experimentation.

A 4 x 3 factorial experiment will be used to develop silvics information—four timber species will be planted in each of three light levels (low, medium, high) established through degrees of canopy closure measured with a spherical densiometer. Each cell will contain 30 seedlings. These will be established on the same aspect and slope and as near to each other as is practicable to constitute one replication. Five full replications are planned.

Seedlings will be graded at the nursery for uniformity of height and root collar diameter (measured with a vernier caliper) within species. We are estimating (but do not know) how long seedlings must remain in the nursery prior to planting-out. We will plant all four study species at the same time using even spacing 50 x 50 cm on understory-cleared 4 x 4 m plots. Seedlings will be numbered and measured immediately following outplanting (height, root collar diameter, number of leaves) and then at 3, 6, and 12 months. Plot edge and interior seedlings will be identified (in case of edge effects). We anticipate that hand weeding will be required at each measurement. Survival and growth will be analysed by species and light level.

Research results will be disseminated at conferences, in journal articles and through briefings to the Son La Provincial Environment Authority. The timber industry and central government Ministry of Forestry will be informed through regular bulletins. Government and industry representatives will be invited to visit the nursery and restoration experiment and to the project open day in 2022.

5 Methodology

Quantitative details of accomplishments are to be found in tables under Part 6, “Achievements against activities and outputs/milestones”.

First, it was critical to develop knowledge of what native tree species were present, and producing fruit and seed in the project area. Mr N. Bon Trinh, botanist with VAFS, was one of key contributors to this project, leading phenological transects in forest at Muong La Nature Reserve. Phenological information was recorded from 39 tree species on 200 individual trees. In the process he found four species that are likely new to science and that he is describing for the international botanical literature (manuscript in review at *Phytotaxa*).

Three surveys were done in two villages and in the Muong La district for **seedling market assessment.** Twelve local officials were interviewed at all levels (province, districts and communes), as well as 15 households in Chom Khau village and 16 households in It village, 17 seedling nurseries, nine wood processing businesses and 6 fruit processing businesses. In addition, three field surveys were done.

The methodology for developing farmer-appropriate production of seedlings involved taking villagers to visit established nurseries, as well as assisting them in their communities with the nuts and bolts of building nurseries. These **two nurseries** were well established by end of the project, with participation mostly by women and hopefully will continue well into the future producing seedlings of various kinds, fruit trees, cinnamon and others, as well as support experiments with little-known but highly valued native forest trees.

Silvics (biological and ecological details of tree species) knowledge was gained first through intensive forest transects and then both greenhouse and outplanting work. First, seeds were collected, germinated and seedlings produced. To determine optimum light levels for survival and growth, seedlings were grown outside (control) and under three different light levels in the 15 m X 15 m greenhouse established by the project at Muong La Nature Reserve. A selection of these seedlings (**three species**) were then underplanted in nearly pine plantation on the Reserve. These will be re-measured in June 2023, six months after project end. The resulting publication will feature results on seedling behaviour in both trials – in **greenhouse and enrichment understorey planting**.

6 Achievements against activities and outputs/milestones

Objective 1: To evaluate market and economic potential for farmers' cooperative native seedling production.

no.	Activity	Outputs/milestones	Completion date	Comments
1.1	Field surveys of MLNR for botanical identification; collation of phenology information	Set up and conducted 13 phenology transects in the 6 months. Mr N.B. Trinh, botanist with VAFS, in process of doing transects discovered potentially **four new plant species** (manuscript in review for *Phytotaxa).* 39 native tree species were selected to monitor phenology information. Labelled and monitored phenology information for 200 trees of 38 native species. A report on the biodiversity of native tree species in Muong La Nature Reserve.	30/11/2022	
1.2	Field surveys of 2 village and Muong La district for seedling market assessment	3 surveys in villages and Muong La district for seedling market assessment. Interviewed 12 local officials at all levels (province, districts and communes), 15 households in Chom Khau village and 16 households in It village, 17 Seedling nurseries, 9 wood processing businesses and 6 fruit processing businesses	31/10/2021	

PC = partner country, A = Australia

Objective 2: To develop farmer-appropriate production of native fruit and timber seedlings.

no.	Activity	Outputs/milestones	Completion date	Comments
2.1	Meeting with stakeholder, establish production groups, developing business plan	Established 2 production groups with regulation and business plans in Chom Khau and It village, certificated by Ngoc Chien and Nam Bam commune. Group 1: It village 15 participants (11 men, 4 women) Group 2: Chom Khau village 15 participants (13 men, 2 women)	20/12/2021	
2.2	Support the farmers visit the community nurseries in the AFLI project	30 farmers, 2 local officials of 2 communes to visit 2 nurseries and 1 fruit farm in Son La city and Mai Son district	27/3/2022	
2.3	Establishing nursery in MLNR station, It and Chom Khau village	Built two nurseries for two production groups and one greenhouse (225 m^2) with irrigation system, lighting control system at the headquarters of the Muong La Nature Reserve produced 13,902 seedlings	30/6/2022	
2.4	Training for Muong La staff on how to produce high quality seedlings	19 technical staff of MLNR, leader of villages and production groups (male 14, female 5) trained to produce high quality seedlings of 5 selected species.	1712/2021	

2.5	Conduct training farmers on business skills	30 farmers trained business skills on operation of the production team experience in running a nursery.	18/2/2022	
2.6	Conduct training famers on nursery skills	Two training sessions were conducted for 02 groups (15 households in It village, 15 households in Chom Khau village) were trained on setting up nurseries, pest control and seedling production techniques of five selected species including *Keteleeria evelyniana, Fokienia hodginsii, Magnolia baillonii, Altingia yunnanensis, Exbucklandia tonkinensis* and 4 fruit tree species (Longan, Mango, Persimmon, Pear).	5/6/2022	
2.7	Coaching farmers, production group in going nursery techniques, propagation skills, business skills	30 farmers in 2 villages receiving supports in capacity building in seedlings production from technical staffs of TBU and Forest Science Centre of NorthWestern Vietnam (FSCNWV) every 2 week to improve managing and nursery skills.	15/12/2022	

PC = partner country, A = Australia

Objective 3: To generate silvics knowledge of selected timber species through experimentation.

no.	Activity	outputs/ milestones	completion date	Comments
3.1	Consultation to confirm focus species for community nursery and experiment.	Report of selection of native species for silvic experiment in Muong La natural reserves	8/10/2021	
3.2	Conduct the germination of selected species.	The selected species seed collected from the phenology transects to germinate with standard method.	15/2/2022	
3.3	Setting up experiments on the light effect on the growth of seedlings	The seedlings from the germination trials were placed in the shade treatment including no shade cloth, light shade cloth (30% shade), medium (50% shade), dark shade cloth (70% shade) and control (no shading) in the greenhouse and then The same seedlings from the glasshouse trials were used in a experimentally designed enrichment planting, with three different light levels (centre of canopy gap, edge of canopy gap and under the canopy).	22/8/2022	
3.4	Monitoring seedling experiment	Germination trials were being monitored and measured mortality and growth heigh every month.	15/12/2022	

PC = partner country, A = Australia

7 Key results and discussion

Through the process of discussion with many parties, including academics, farmers, and rangers, we chose key native species of interest for domestication to investigate. Transects were then established at Muong La Nature Reserve (MLNR) to record the flowering and seeding times of key native species. Seeds were collected and successfully used to grow seedlings, primarily at a large greenhouse at MLNR, and used for light-level experiment and planting out. It is the intention that the survival and growth of these trees will be monitored into the future.

In addition to building the greenhouse at MLNR and using it for seedling production, two community nurseries were established, one at It village, with Thai people and another at Chom Khau with Hmong people. Both of these are within a few kilometres of the park office. Here local people are growing mainly fruit trees, which they will incorporate into their farming systems, but also seedlings of native tree species, which we hope will become an increasing component of the landscape.

Thus we have now some preliminary knowledge of these species particularly:

Fokienia hodginsii, Michelia balansea, Keteleeria evelyniana (culturally significant to Hmong people and a threatened species) A*ltingia yunnanensis* and *Exbucklandia tonkinensis* (important food source for the Western Black-Crested Gibbon, a critically endangered primate species that lives in MLNR).

The successful use of these and other native tree species will depend on continued efforts by all concerned.

8 Impacts

a. Scientific impacts – now and in 5 years

We aim to increase our understanding of the silvics of at least these five important but little known tree species

1. Po mu (*Fokienia hodginsii*),
2. Xoi Suong (*Michelia/Magnolia balansea* – good timber and quick grow),
3. *Keteleeria evelyniana* – significant species for Hmong and threatened,
4. *Altingia yunnanensis* and
5. *Exbucklandia tonkinensis* (gibbon food species)

For now, this project and the previous FST/2016/152 in which VAFS and SCU combined to plant ~70 "scattered tree planting blocks" at Nai Bai and Na Noi villages, as well as understorey enrichment plantings at both locations, have introduced and promoted the new idea of planting native tree species. This is in contrast to the norm in Vietnam and around the world in tropical countries, which is to establish single-species plantations of only a few species pines, eucalypts, teak and acacias.

This project, particularly if followed up on by the agencies and farmers involved, can lead to an agricultural landscape that includes more trees, especially more native trees on the farms of the region.

b. Capacity impacts – now and in 5 years

The research institutions involved are the Vietnamese Academy of Forest Sciences (VAFS), Tay Bac University (TBU) and Southern Cross University (SCU). During the previous large agroforestry project FST/2016/152 and this SRA SCU researchers took many opportunities to build the academic capacity of the small regional university TBU, particularly in terms of designing field experiments and in basic statistics.

VAFS already has several MSc and PhD graduates from within and without Vietnam. Some of them were able to share their expertise in nursery practices, seed collection, and establishing field trial tree planting experiments.

In five years' time, we hope that TBU has become a more prominent university with more academic staff able to initiate and complete scientific experiments and publish them in the domestic as well as international literature.

Two community groups develop their capacity to build and maintain nurseries, at It village and Chom Khau. This was done primarily with fruit trees and involved not only growing seedlings but grafting.

c. Community impacts – now and in 5 years

This project is based out of the regional centre of Son La, northwest Vietnam, a medium-sized city that is approximately ten hours' drive from Hanoi. It is not serviced by commercial airlines, although there are flights from Dien Bien Phu, which is four hours' drive. The impact of this project in Son La is to bring scientists and reforestation specialists into a collaborative project with the new Muong La Nature Reserve personnel, and especially with the staff of Tay Bac University, the major local tertiary institution.

The northwest is well known for the presence of minority ethnic groups, who are not members of the majority “Viet” population. Muong La Nature Reserve and its office (with project greenhouse) sit atop a major mountain dividing regional zones. On either side of the ridgetop the project assisted with forming community nurseries, one at It village with Thai people and the other at Chom Khau with Hmong people. In both of these cases, villagers, almost entirely women, were able to produce tree seedlings for planting on their farms, mostly seedlings of well-known fruit trees, although a few of native forest species.

This project has introduced the idea that seedlings produced from collecting in the local native forest may be worth planting out on farms, whilst the farmers or their parents or grandparents may have been active in eliminating many of the same species to establish farms. We would hope that, with follow-up and encouragement from Reserve rangers, academics at Tay Bac University, foresters and researchers from VAFS, and perhaps continuing support from Australian scientists, these nurseries – and the trees they produce – will continue to thrive.

i. Economic impacts

In general the serious problem of north west Vietnam is that current farming systems do not provide adequate livelihoods for local people, as well as causing serious problems with loss of soil on steep slopes. Thus this is one of many endeavours attempting to rectify this situation: to find agroforestry and agricultural systems that provide well for landholders whilst also maintaining productive capacity of land and encouraging higher levels of biodiversity.

Through this project farmers and villagers of two ethnic minorities were able to widen their possible sources of income, through being capacitated in nursery practices for both fruit and forest trees, and to be introduced to alternative crops that could at least be part of their farming systems.

ii. Social impacts

This project encouraged positive interactions among scientists, local and regional officials, farmers, and members of Thai and Hmong ethnic groups.

iii. Environmental impacts

The main objective of this work was to begin valuing native tree species and incorporate their use into farming and agroforestry systems.

d. Communication and dissemination activities

The research used various means for communication and dissemination (blog stories, Facebook, Zalo and, trainings, etc) to increase the research’s visibility in study area. The research produced two technical reports by survey and interviewed local partners and farmers, report of training session to evaluate before and after training. The communication of research about productive groups and native species received attention from local authorities and had a change in change forest and agricultural development policy commune. The research team was also invited to contribute to ACIAR in Vietnam Newsletter issued in 2023.

9 Conclusions and recommendations

a. Conclusions

We conclude that though until recently the focus in northwest Vietnam was on clearing forest, there is growing interest in “domesticating” valuable native tree species and incorporating them into farming and agroforestry systems. One way to do this is to combine the growing of native forest seedlings with production of known commercial tree species in community nurseries, as well as at government nurseries.

Transects in little-known forest revealed useful information on phonology of some 39 native tree species, as well as enabling the description of potentially four previously-undescribed species.

b. Recommendations

We recommend continuing this very preliminary work, which lasted only 18 months, a short period in the life cycle of even very fast-growing trees. There is now an excellent infrastructure in place: two community nurseries and a large greenhouse at Muong La Nature Reserve.

10 References

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(persons involved in this project highlighted **in bold**)

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b. List of publications produced by project

(drafts attached)

(proposed): 1. Techniques for seedling production and survival and growth of three native Vietnamese tree species in relation to light levels (greenhouse trials.

2. Results of enrichment plantings – survival and growth underneath existing pine plantation at Muong La Reserve

11 Appendixes

a. Appendix 1: Photos of project activities

Erythrophleum fordii at Leo village near Na Bai photo by Hanh Thi Le. Enrichment planting This is from previous FST/2016/152 but is species considered by current SRA.

Underplanted seedlings at Muong La Reserve, above and below


PIC·COLLAGE

Greenhouse at Muong La Reserve headquarters.

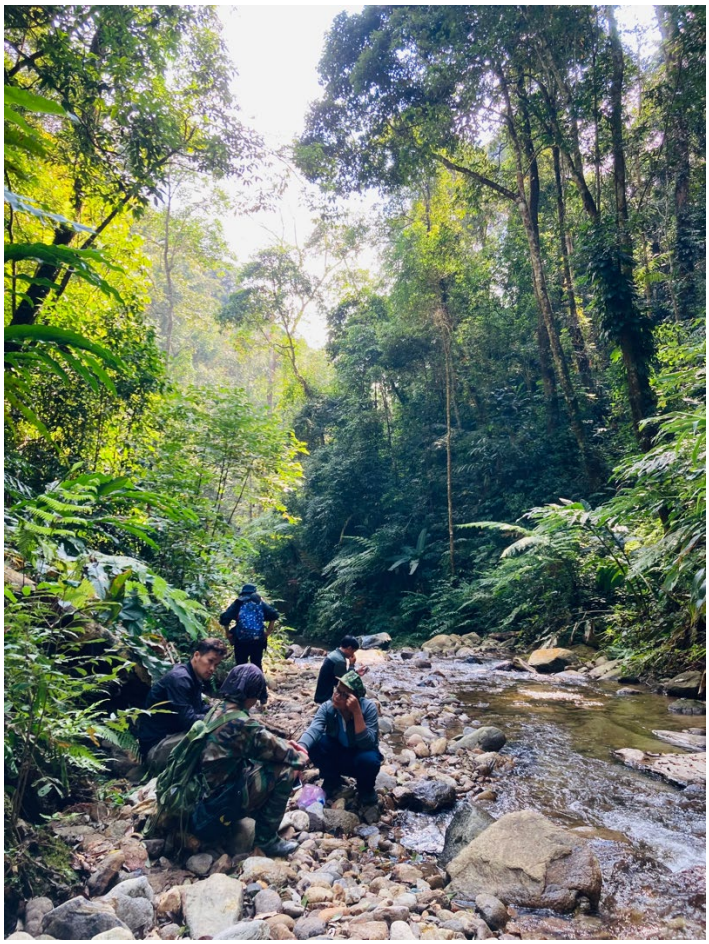
Ha Thi Do at Muong La Reserve glasshouse (15m X 15m), with native tree seedlings.

Ha Thi Do with native forest tree seedlings for shade level trials and enrichment plantings.

Mr Ngoc Bon Trinh, botanist with Vietnamese Academy of Forest Science, giving presentation to rangers of Muong La Reserve and staff of Tay Bac University. Whilst doing forest transects at MLNR he found four species “new to science”.

It village nursery, near Muong La Reserve headquarters.

Two nurseries established as part of this project. At top at It village, Thai ethnic group. ,bottom photo, at Chom Khau village Hmong group.



Doing transect in native forest in Muong La Nature Reserve, making phenological observations on four transects of 200 trees each.