

Conserving Rosewood genetic diversity for resilient livelihoods in the Mekong

Annual Workshop (Virtual Event) – 9, 10, 15 December 2020



Rosewood trees on a farmland, central Lao PDR. Photo: C. Bounthiphon, FRC



Alliance



RESEARCH PROGRAM ON Forests, Trees and Agroforestry

Welcome and introduction

Professor John Mackay, Project Coordinator, welcomed the participants to the workshop and gave a brief overview of the project. Working with forestry authorities and rural communities in Cambodia, Lao PDR and Vietnam, the project uses *in situ* and *ex situ* methods to safeguard the genetic resources of three *Dalbergia* rosewood species of high conservation concern, namely *Dalbergia cochinchinensis*, *D. oliveri*, and *D. cultrata*. The project develops novel and strengthens existing capacity for seed collection, seed source and nursery management and associated value chain development. The project also builds the capacity of rural households to generate livelihood benefits from sustainable use of these resources. The project is funded by the UK Darwin Initiative and runs from July 2018 to December 2021. This includes a 9-month extension granted due to delays to field work by the Covid-19 pandemic in 2020.

The Virtual outreach event had the following objectives:

- Create an opportunity for project partners and collaborators to share their work in *Dalbergia* conservation and genetics research
- Highlight successes and reflect on accomplishments, results, challenges as we move the project forward

Presentations from the event are available [here](#).

Presentations

Mr Chaloun Bounithiphon from Forest Research Centre presented the project's progress in Lao PDR. The project team has identified *in situ* conservation sites in the project area in Nong and Thapangthong districts in Savannaketh province. Seed collections have been carried out in several provinces, and *ex situ* collections for *Dalbergia cochinchinensis* and *D. cultrata* will be established in Nong district and Vientiane in May 2021. Two trainings-of-trainers were organised in the past one year, on *in situ* and *ex situ* conservation, and on seed and seedling marketing. Subsequently, local community members in the project sites in Savannaketh province were trained in nursery establishment, and a seed supply network was initiated among seed collectors and seed tree owners. Seed collection for the target species in natural populations is becoming increasingly difficult. During a recent collection trip in several provinces, the team had difficulties in finding mature trees and seed yields were low. In some instances, trees identified during previous field work had been cut down and the land converted to agriculture. Climate change also seems to be affecting phenology, and in some areas trees fruited earlier than expected.

Discussion

- Participants asked for more details on *D. cultrata* conservation in Lao PDR, including number of populations and mother trees. According to Mr Bounithiphonh, five provinces were surveyed in 2020 but few mature trees were found. Trees in Savannaketh province were mature and fruiting, but in other provinces the identified trees were still young. Only one or two trees per site were producing seed.



Figure 1. Nursery for *Dalbergia* seedlings established by the project team in Savannaketh province, Lao PDR.

Dr So Thea from the Institute of Forest and Wildlife Research and Development, Cambodia, presented his team's work in assisting local farmers in supplying good quality seedlings. An active farmer was selected to receive training and support in seed and seedling production. The farmer was previously trained in good seed collection practices and is committed to producing quality seed. He supplies *D. cochinchinensis* and *D. oliveri* across the country, as well as other valuable species such as *Pterocarpus macrocarpus*. Demand for seedlings is growing. Through the project, the farmer was assisted in upgrading his nursery from the capacity of 40,000 to 90,000 seedlings per year, and costs were shared between the farmer and the project. Additionally, the farmer and local Forestry Administration staff were trained in grafting technique, and a seed source of *D. cochinchinensis* was then established through grafting on the farmer's land. After the experience, the farmer is also interested in establishing a seed source for *D. oliveri*, but seedling costs and land availability are a concern. In terms of seedling sales, the farmer's aspirations are to bypass middlemen and sell seedlings directly to customers instead. This requires improving advertisement, for example by distributing name cards or visiting end-users. Currently, the farmer advertises seedlings through Facebook.



Figure 2. A farmer being trained on grafting of *Dalbergia cochinchinensis* in Pursat province, Cambodia. Grafted plants were used for establishing a seed source for the species.

Discussion

- What are the possibilities for growing crops within the tree plantings of the grafted plantings to reduce costs? Some agricultural crops can be introduced, for example ginger or banana. Farmer had tried papaya, but the soil was not suitable.
- What could increase small-scale farmers' interest in planting? Or are there other stakeholders that should be targeted instead?
 - Small-scale farmers do not appreciate planting *Dalbergia* although they know the high value. Land availability and the long time span are problems. But large-scale land holders don't have these issues as they can afford to buy seedlings. One way to encourage farmers to plant trees can be through demonstration at existing plantations. Private companies have such plantations in Kampong Speu province, established 15 years ago and with trees currently at 20 cm dbh.
 - Lao also has the same problem – farmers are not really interested in conservation as they are only thinking of the value of timber which is realised in long term. Activities that yield benefits in shorter term are needed, such as the seed supply network. However, the number of mature trees for seed collection is very limited and market sustainability is also not clear

Dr Tran Thi Hoa, Vietnam Academy of Agricultural Sciences, shared the project's activities in establishing conservation units and making seed collections. In Vietnam, farmers used to have scattered *Dalbergia* trees on their lands, but today, populations remain only in national parks, and there are only 10-100 trees per site. Chu Mom Ray is the only National Park with sizeable populations of mature trees. In situ conservation sites for both *D. cochinchinensis* and *D. oliveri* were

identified in the Park. Activities to protect the trees include guard patrols, fire control, zoning to promote regeneration and sample collection for genetic studies. Through the project's activities, the Park authorities have for the first time allowed villagers in the area to collect seed from the Park for establishing a nursery. Training on nursery establishment was provided for interested villagers in the Park's buffer zone. Training participants were mainly women farmers and older men who have the most experience in seed collection and conservation.

Discussion:

- What is the type of the established *ex situ* conservation site? It is mainly for a seed orchard. Government encourages the National Park to do this activity. There is a national certification system for seed, and the next step would be to try to obtain that certification and then market seed. Seed can also be sold to national organisations focused on seed preservation.
- Will the *in situ* conservation units have any legal status? Have they been publicised somehow? The establishment of the sites is documented in the National Park documents.



Figure 3. Approximately 1000 seeds of *Dalbergia oliveri* could be collected from stands within the Chu Mom Ray National Park, Vietnam.

Dr Riina Jalonen from the Alliance of Bioversity International and CIAT shared results of species distribution and threat mapping for the project's target species. Distribution models for current and future climates were prepared using species occurrence records. In addition to climate change, threat exposure maps to overexploitation, habitat conversion, fire and overgrazing were prepared using available global datasets. Threat vulnerability maps were then prepared for each species taking account their traits such as growth rate and bark thickness. All species were vulnerable to overexploitation in large parts of their modelled range. *Dalbergia oliveri* was the most vulnerable to habitat conversion and climate change, especially in north-eastern Thailand and southern Cambodia and Vietnam. Based on the results, priority sites for *in situ* and *ex situ* conservation and restoration

were identified. In areas where the species are highly vulnerable to climate change, *ex situ* was considered the only viable option. Global ecoregions map was used as a proxy for adaptive variation within the species, and high priority ecoregions for conservation and restoration were identified. These included Northern Khorat Plateau moist deciduous forests in Lao PDR and Thailand, Southern Vietnam lowland dry forests, and Tonle Sap – Mekong peat swamp forests in Cambodia and Vietnam.

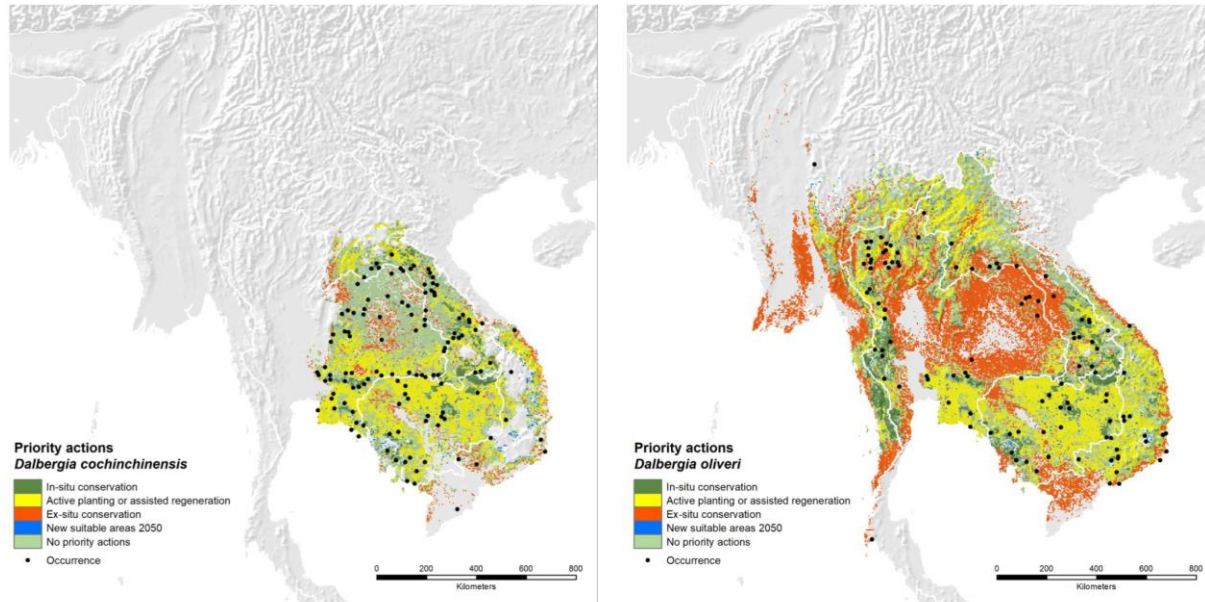


Figure 4. Conservation and restoration priorities for *Dalbergia cochinchinensis* and *D. oliveri* in Greater Mekong region.

Discussion:

- Are there actions we can take within the project over the next year? The results can inform the establishment of *in situ* conservation sites and provenance trials, as well as seed collections. Conservation measures should ideally cover all ecoregions where the species are found.
- Can the results be used to identify priorities for *circa situ* conservation on farms? Potentially yes. Possible *circa situ* sites could be in areas where some land conversion has occurred in the landscape but where threats are otherwise low.

Dr Huang Ping of the Research Institute of Forestry, Chinese Academy of Forestry, presented highlights of an associated project “Conservation, evaluation and analysis of key germplasm resources of *Dalbergia* spp. In Asia and the Pacific”, coordinated by the Chinese Academy of Forestry and funded by the National Science Foundation of China. There are in total 28 *Dalbergia* species found in China, with most being near threatened or endangered. Distribution modelling studies by the project team indicate that *D. cultrata* is sensitive to the fluctuation of temperature and precipitation. This is expected to apply to also other subtropical *Dalbergia* species. Nuclear and chloroplast genomes of *in total six Dalbergia* species have been resolved (Liu et al. 2019). Microsatellites markers for *D. cultrata* were developed and used to assess its genetic diversity and population structure in China. Results indicate that the populations are genetically differentiated by

geographic distance, and genetic diversity is lower in marginal populations. Inbreeding was found in wild populations, resulting from habitat fragmentation and reduction in population size. A small field genebank has been established to help conserve the species' genetic diversity. Collaboration with other countries could be expanded, for example through sharing materials and data, preparing joint publications, coordinating *in situ* or *ex situ* conservation efforts and organising academic visits or trainings. A 15-day training course on institutions and capacities for genetic resources conservation and use is being planned as part of a new Forest Genetic Resources Training Centre, funded partly by the Ministry of Science and Technology of China.

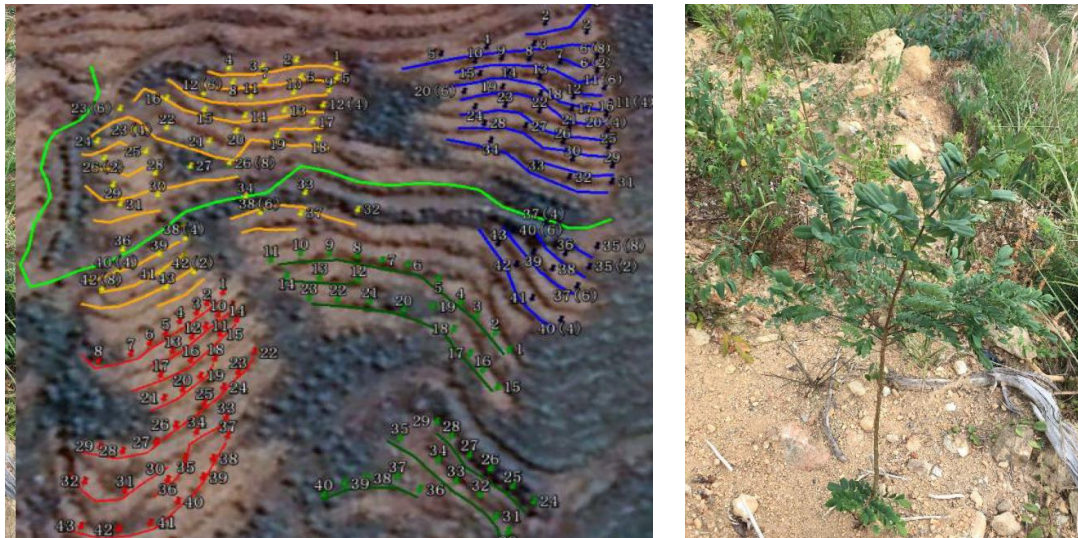


Figure 5. A field genebank for *ex situ* conservation of *Dalbergia cultrata* in Yunnan, China, with material collected from distinct populations.

Discussion:

- Can you provide more details of the evidence of elevated inbreeding due to fragmentation? New experiments are being designed to assess inbreeding in more detail. Information about geneflow in populations is available.

Mr Henry Tin Hang Hun from University of Oxford presented progress on genomic studies of *Dalbergia cochinchinensis* and *D. oliveri*. There are genetic bottlenecks in the seed supply chain resulting from poor collection practices, maladaptation to planting sites and in future likely also climate change. In this context, ensuring sustainable supply of genetically and adaptively diverse germplasm for forest restoration is a challenge. The team has published six reference transcriptomes and prepared a chromosomal-scale genome of *D. cochinchinensis*. In the next steps, 500 genotyped samples of *D. cochinchinensis* will be correlated with 20 environmental variables at sampling locations, including variables on soil and vegetation, elevation, temperature and precipitation. The results will be used to assess spatial coincidence between genotype and environment under current and future environmental conditions, to predict whether the populations are likely to become maladapted in future. Similar study for *D. oliveri* is planned but could not be initiated yet due to insufficient samples. Heat and water stress experiments by the team revealed that the two *Dalbergia* species have different physiological stress responses (Hung et al. 2020). Stress experiments will be continued to compare responses of different ecotypes.

Discussion:

- It would be interesting to compare the results of genetic vulnerability under future climate conditions with the predictions of climate change vulnerability performed by the Alliance of Bioversity and CIAT.

Plenary discussion

Discussion ensued about how to maintain the conservation units beyond the project. Project team in Lao PDR had discussed with the Department of Forestry about the importance of considering distribution range of *Dalbergia* species in the country, and formally designate conservation units covering the distribution. Conservation units should be integrated in national regulations.

Participants considered sustaining efforts to plant *Dalbergia* crucial for genetic conservation, but also challenging. Project team in Lao PDR is planning to discuss planting efforts with the Ministry of Agriculture and Forestry to help promote planting. In Vietnam, getting local communities interested in seed value and seed sources would be key, to help motivate conservation of seed sources and the establishment of seed orchards.

Future collaboration opportunities were discussed briefly. It was acknowledged that there are multiple species requiring conservation action, some of which are becoming very rare, and this complicates conservation through sustainable use. On the other hand, diversity of species, contexts and approaches between the countries in the region is not necessarily a problem but can also be a strength. Projects that are able to bring partners together to collaborate on species conservation and sustainable use between several countries are often appealing to international donors.

Closing

John MacKay and Riina Jalonen thanked all presenters and participants for the active discussion. The session's presentations highlight how the project is producing many resources from range-wide conservation assessments to genome assemblies and local stakeholder engagement, which support conservation and sustainable use of the threatened *Dalbergia* species. Insights from the discussion will be used to inform subsequent workshop sessions among project implementing team on impact pathways and future work planning as the project enters its final year in 2021.