



## Darwin Initiative: Final Report

To be completed with reference to the “Writing a Darwin/IWT Report” Information Note:  
(<https://www.darwininitiative.org.uk/resources-for-projects/reporting-forms-change-request-forms-and-terms-and-conditions/>).

It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

### Darwin Project Information

Project reference	25-023
Project title	Conserving Rosewood genetic diversity for resilient livelihoods in the Mekong
Country(ies)	Cambodia, Lao PDR, Thailand, Vietnam
Lead organisation	University of Oxford
Partner institution(s)	Bioversity International (Malaysia) Institute of Forest & Wildlife Research & Development, Cambodia Forest Science Research Center, National Agriculture & Forestry Research Inst., Lao PDR Forest Genetics & Conservation Dept, Center for Biodiversity & Biosafety, Vietnam Academy of Agricultural Sciences University of Copenhagen, Denmark
Darwin grant value	GBP 409,897
Start/end dates of project	1/7/2018-31/12/2021
Project leader’s name	Prof. John MacKay
Project website/blog/social media	<a href="http://www.apforgen.org/initiatives/conserving-dalbergia">http://www.apforgen.org/initiatives/conserving-dalbergia</a>
Report author(s) and date	John MacKay, David Boshier, Riina Jalonen, with input from partners Dr So Thea, Mr Syneath Sreng (Cambodia), Mr Bansa Thammavong, Mr Chaloun Bounithiphonh (Lao PDR), Dr Tran Thi Hoa (Vietnam) 14/4/2022

## 1 Project Summary

Rosewood (*Dalbergia* spp.) is an extremely valuable timber. Over-exploitation has significantly reduced most species in their natural range, with rapid depletion of Siamese (*Dalbergia cochinchinensis*) and Burmese (*D. oliveri*) rosewoods in Cambodia, Laos, Myanmar, Thailand and Vietnam. Trees are largely restricted to protected areas, but illegal harvesting, even of roots, continues. Associated forest degradation compromises rural livelihoods (60-80% of population in participating countries), with a range of problems related to rosewoods identified by national organizations (forestry, conservation, police). In 2022, it was recommended that both species be ranked as “Critically Endangered” on the IUCN Red List. CITES CoP17 placed the *Dalbergia* genus on Appendix 2, imposing restrictions on international trade. IUCN identified a need to better define and understand conservation status through research on population size, distribution, and trends. Across the Greater Mekong Subregion, country-identified limits to conservation efforts include: 1) limited capacity to generate livelihood benefits for and by local communities from forest restoration, 2) lack of information about remaining populations and their conservation value; 3) limited capacity and lack of cross-country collaboration to establish a network of conservation units that effectively conserves genetic diversity; 4) acute lack of *Dalbergia* planting material.

Community nurseries are popular in restoration, but livelihood benefits for women and men are constrained by lack of attention to seed sources, germplasm quality and market linkages. Research shows community nurseries and restoration of endangered species are particularly susceptible to genetic bottlenecks through poor collection practices. Low genetic diversity can lead to low seed production, reduced survival, and growth, compromising both current and future use, conservation and adaptation.

Our (gender-equitable) approach is complementary to legal structures (national/international), to ensure *Dalbergia* genetic resources are conserved for the future while available and used by the region’s communities. Illegal logging is associated with violence against government officials and local people and cannot be addressed for security reasons, though cross-country action on species conservation may facilitate greater collaboration to combat illegal trade in rosewoods.

Strengthening community participation in biodiversity conservation is a stated policy goal of each country partner, however, limited progress has been made on this front, partly because of a lack of tangible incentives for local forest-dependent communities. The project is implemented within the framework of National Forest Policies and National Biodiversity Strategies and Action plans, to support existing efforts and targets in the project countries. The project is active through country partners and local communities within the natural distribution of three *Dalbergia* rosewood species (*Dalbergia cochinchinensis*, *D. cultrata*, *D. oliveri*) in three Greater Mekong Subregion countries (Cambodia, Lao PDR, Vietnam).

## 2 Project Partnerships

The project arises from and contributes to the activities of an existing regional network APFORGEN (the Asia Pacific Forest Genetics Resources Program). National Coordinators of the member countries selected species conservation and seed production strategies as objectives in the network’s new 5-year strategy (see [www.apforgen.org](http://www.apforgen.org)). They selected *Dalbergia* as one of three priority genera to develop collaborative research and conservation strategies, identify synergies and address gaps for more effective conservation outcomes and use of threatened resources. The project was jointly developed by all partner institutions, with the University of Oxford and Bioversity International facilitating the process. All partners participated in the inception and further workshops in years 2 and 3; they were fully involved in shaping the detail of planned activities (as reflected in the inception and other annual workshops). Partners identified and chose the communities and areas to work in, as well as sites for collection and trial establishment.

During the project we made administrative changes to our partnership as it was found that the Thai partner could not engage on the ground with the proposed plan of work and had concerns with the funding guidelines (see section 6.1 of the report for details). The project faced ongoing

challenges for the dispersion of funds from Oxford to partners and this required continued attention as discussed (see section 6 of the report). The COVID-19 crisis posed definite challenges, which we addressed by close monitoring, extending the project timeframe by 9 months, implementing alternative plans, and developing online meetings, workshops, and outreach events (see section 8).

The partnership will continue through future regional workshops such as those run by APFORGEN, newly funded projects, and potentially with the funding from applications that are in preparation (section 5, last paragraph).

The project's inception workshop in Vientiane was preceded by a Project Launch ceremony presided over and addressed by the British Ambassador to the Lao PDR (Mr Hugh Evans) in which he highlighted the problem of the Illegal Wildlife Trade (IWT) and the UK government's commitment and initiatives to support efforts to combat this (see Fig 1). Though contacts were also made with the British Embassy in Cambodia, further involvement in the project was precluded by COVID 19.

**Figure 1** (top) Princess Beatrice plants a *Dalbergia cochinchinensis* sapling in the grounds of the British Embassy in Vientiane, Lao PDR. (bottom) HE Ambassador Hugh Evans at the launch of the Darwin project.

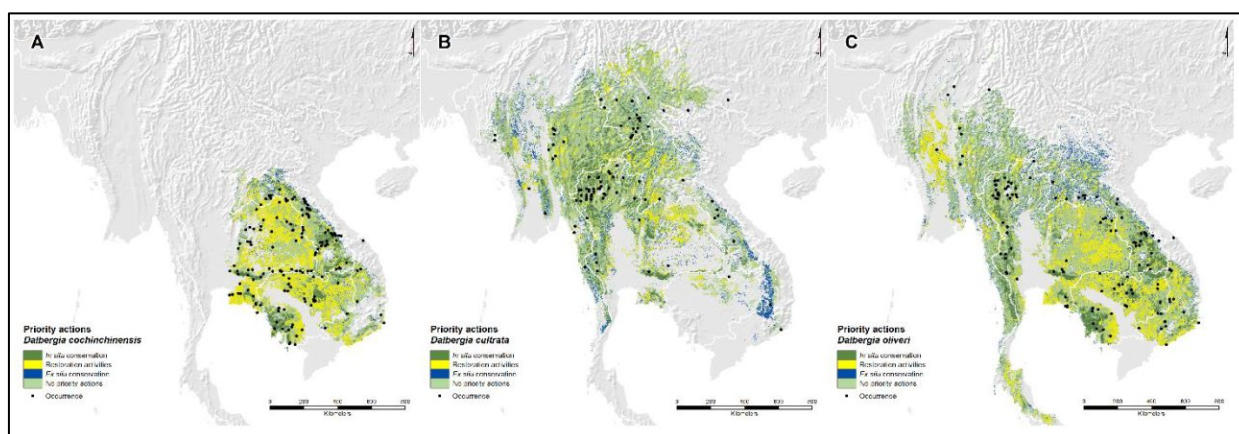


### 3 Project Achievements

#### 3.1 Outputs

##### Output 1: Regional assessment of the conservation status of *Dalbergia cochinchinensis*, *D. oliveri* and *D. cultrata*

Output 1 was well achieved. Before the project inception, the distribution and conservation status of the three Rosewood species in the Greater Mekong region was uncertain. The most recent published IUCN Red List status assessments were from 1998 for *Dalbergia cochinchinensis* and *D. oliveri*, and from 2012 for *D. cultrata*. As a result of the project, updated and expert-validated distribution and threat maps were developed (Indicator 1.1) and priority areas for *in situ* and *ex situ* conservation were identified (Indicator 1.4, Figure 2, Annex 7.1). The maps indicate habitat suitability for each of the species across their confirmed range; changes due to forest cover loss; areas where the species are predicted to be most vulnerable to overexploitation and climate change; and protected area coverage. Global ecoregions were used as a proxy for tree seed zones, each of which is expected to harbour unique genetic adaptations and, therefore, warrant conservation measures for the target species. The resulting maps are freely available at an online database [www.tree-diversity.org/interactive-map](http://www.tree-diversity.org/interactive-map). In addition to the project countries, species occurrence data and expert feedback on distributions was obtained from collaborators in other countries within the species native range (China, Myanmar, and/or Thailand, depending on the species), and the maps, therefore, cover not only the three project countries but each species' entire native range. The project team was invited by the Global Tree Assessment to contribute to updating the IUCN Red List assessment for the three species. The assessments were submitted to IUCN in March 2022 and are expected to be published in the 2<sup>nd</sup> half of 2022.



**Figure 2.** Priority action maps for *in situ* and *ex situ* conservation and restoration were developed for (a) *Dalbergia cochinchinensis*, (b) *D. cultrata*, and (c) *D. oliveri*. Source: Gaisberger et al. (2022, Annex 7.1)

A database of species known occurrences across their range was developed, including newly established *in situ* reserves, *ex situ* collections and seed sources (Output 2) ([www.tree-diversity.org/data-repository](http://www.tree-diversity.org/data-repository)) (Indicator 1.2). Moreover, 354 occurrence points, excluding previously unpublished and sensitive data, were submitted to the Global Biodiversity Information Facility (GBIF) to support further research. A scientific research paper on the results is under review at the journal *Biological Conservation* (Annex 7.1). A summary of the results for policy-makers and practitioners is available [here](#) (indicator 1.3/1.4). Genomics research at Oxford to fill knowledge gaps of adaptation in *Dalbergia* produced a landscape genomic study (800 samples) across the Mekong sub-region (as part of a PhD thesis). Two research papers were prepared publication (to be submitted to scientific journals in 2022) including high-quality genome assemblies, new findings on population structure and identification of DNA markers indicative of adaptation to environment factors (Indicator 1.3/1.4).

### **Output 2: Filling gaps to conserve *Dalbergia* genetic resources through *in situ*, *ex situ* programmes and provenance testing**

The output was well achieved. The project established a total of 22 new conservation units (CUs) out of a target of 23 (indicator 2.1) covering the three species and three countries (details in Table 1). Relative to the baseline data, this represents an increase of approximately 50%. Conservation Units in Vietnam and guidelines for their management were officially registered with the provincial Department of Agriculture and Rural Development (Annex 7.2). Some populations became more degraded over time, restricting the options for establishing *in situ* CUs as reflected in Table 1. An opportunity arose to set up *ex situ* CUs from the provenance trial we established in Cambodia; and similar plans are in place for Lao PDR, which would ultimately bring the total to 28 CUs (see Table 1). The development and sustainability of CUs was supported by training 99 (34% women) forestry and conservation officers on *in situ/ex situ* conservation, significantly surpassing the target (indicator 2.2.) across Cambodia, Lao PDR, and Vietnam (Annex 7.3). The training in Vietnam was restricted because of COVID but we were able to provide online training (and study materials) to >half of the participants, which was very well received and indicated that this approach may be fruitful for future projects.

We also collected seeds from several populations and used them to establish provenance trials. We made 17 new seed collections against a target of 15 (indicator 2.3), distributed across Cambodia (5 collections in yr2, Lao PDR (3 in yr3 and 5 in yr4), and Vietnam (2 in yr3 and 2 in yr 4). The number of trees per collection was slightly lower than expected due to continued illegal logging. The physiological quality of seed was low in general and the Vietnam partners have found signs of disease affecting seed viability, which is being investigated further. Using these seed collections, provenance trials were set up at the national level as Covid restrictions made regional trials impractical. The trials were in Cambodia (*D. cochinchinensis*, 5 provenances at 1 site) and Lao PDR delayed due to Covid restrictions will be established in July 2022 (*D. cochinchinensis* 4 provenances, *D. cultrata* 1 provenance, *D. oliveri* 1 provenance, all at 1 site). The total (2 sites, 11 provenances and 3 countries) is slightly lower than the target (3 sites, 8 provenances, and 3 countries; indicator 2.4); however, the partners are committed to continue

monitoring and maintenance and have decided to convert both trial sites into *ex situ* conservation units (11 provenances).

**Table 1:** Designated Conservation Units (target in parentheses).

		Cambodia	Lao PDR	Vietnam	Total
<i>Dalbergia cochinchinensis</i>	<i>In situ</i>	1 (2)	2 (3)	1 (1)	4 (6)
	<i>Ex situ</i>	6* (1)	2 (2)	1 (1)	9 (4)
<i>Dalbergia oliveri</i>	<i>In situ</i>	0 (1)	1 (3)	1 (1)	2 (5)
	<i>Ex situ</i>	1 (0)	1 (2)	1 (1)	3 (3)
<i>Dalbergia cultrata</i>	<i>In situ</i>	0 (0)	2 (3)	0 (0)	2 (3)
	<i>Ex situ</i>	0 (0)	2 (2)	0 (0)	2 (2)
<b>Grand Total</b>		<b>8 (4)</b>	<b>10** (15)</b>	<b>4 (4)</b>	<b>22 (23)</b>

\* The provenance trial established by the project also serves as 5 *ex situ* CUs;

\*\* The establishment of six further *ex situ* CUs is planned from the provenance trial to be planted in Lao PDR (see indicator 2.4)

### Output 3: Multiplication to support use, income generation and reduced pressure on natural populations (propagation strategies, community nurseries etc)

The output was largely achieved. Before the project, a vegetative propagation method for *D. cochinchinensis* was not publicly available, although attempts to propagate it vegetatively had been made by individual institutions due to the high demand for material and irregular seed production. As a result of the project, vegetative propagation methods are now available for both rooted cuttings and grafting. The [protocols](#) (Annex 5) were published in both English and Khmer languages (Indicator 3.1) and the grafting technique was used in a farmer’s nursery to secure genetic resources of *D. cochinchinensis* and *D. oliveri* and establish seed orchards (Figure 3).



**Figure 3:** Farmer grafting *D. cochinchinensis* plants in Pursat, Cambodia (left). Grafted seedlings are covered with a plastic bag to retain moisture (right).

The project’s baseline household survey showed that 13% of interviewed households had collected *Dalbergia* seed over the past year in Cambodia, 3% in Laos and none in Vietnam (Annex 7.4). [Recommendations for overcoming barriers to seed supply](#) were identified through participatory, sex-segregated discussions in the project communities, and through interviews with other supply chain actors (Annex 5, Indicator 3.2). Target for training forestry professionals on community-based seed supply was exceeded, with 73 professionals (26% women) trained against a target of 60 (122% of target, Indicator 3.3). Target for training local community members on seed collection and seedling production was largely met, despite the Covid-19 -related

restrictions for field travel and gatherings (149 trained of whom 33% women; 85% of target, Indicator 3.4, Annex 7.3).

Target for multiplication was met with two nurseries and two farmer seed sources established, and one farmer's nursery upgraded (125% of target, Indicator 3.5) as follows (Figure 3):

- Cambodia: one farmer nursery in Pursat province upgraded from 40,000 to 90,000 seedlings capacity per year.
- Cambodia: two farmer seed sources established in Pursat province, one each for *D. cochinchinensis* (195 plants, 0.45 ha) and *D. oliveri* (61 plants, 0.3 ha)
- Lao PDR: a community nursery established in Savannaketh province, with a capacity of 14,000 seedlings.
- Vietnam: a new nursery established in Chu Mom Ray National Park by Park staff and local community members, producing 600 *D. cochinchinensis* seedlings and some *D. oliveri* seedlings.

In addition, a seed supply network was established in Laos in consultation with the District and Provincial Agriculture and Forestry Offices, involving 7 families from 6 communities (2 communities each in Nong district and Thapangthong district, Savannaketh province, and 2 communities in Khamkuet district, Bolirkhamsay province). This expanded the project activities beyond the targeted 3 communities in Laos. At the end-of project survey, proportion of households collecting *Dalbergia* seed had increased to 20% in Cambodia, 4% in Laos and 17% in Vietnam (Table 2, Annex 7.4). Lack of seed sources near project sites in Laos hindered more households from getting involved in seed collection.

**Table 2:** Change in seed collection, income and tree planting in project communities during the project. Numbers in parentheses indicate %-change between the years. Percentage change could not be defined where baseline value was zero (ND). For details see Annex 7.4.

Indicator	Cambodia		Lao PDR		Vietnam	
	2019	2021	2019	2021	2019	2021
% of households collecting <i>Dalbergia</i> seed (past 12 months)	13	20 (+56%)	3	4 (+69%)	0	17 (ND)
% of households selling <i>Dalbergia</i> seed (past 12 months)	17	17 (-4%)	0	16 (ND)	0	17 (ND)
Mean annual income from tree seed sales (gross, excluding households not selling seeds), US\$	300 ± 373	569 ± 971 (+89%)	0	138 ± 54 (ND)	0	43 ± 25 (ND)
% of households planting <i>Dalbergia</i> spp.	64	80 (+25%)	4	7 (+69%)	25	0 (-100%)

The target to increase households planting *Dalbergia* (Indicator 3.6, target 30% increase) was met partially. The project baseline indicated that 4% of interviewed households in the project communities in Lao PDR, 25% in Vietnam and 64% in Cambodia had planted *Dalbergia* trees over the past 3 years (Annex 7.4). These numbers increased to 7% in Laos (69% increase) and 80% in Cambodia (25% increase), while in Vietnam, no households reported planting *Dalbergia* in 2021. In Vietnam the most reported reasons for not planting trees in 2019 were lack of money to buy inputs (59% of respondents), followed by lack of seeds or seedlings (57%) and lack of knowledge how to plant trees (57%). In 2021 the most common reasons were lack of money to buy inputs (68% of respondents), followed by lack of suitable land and manpower (both 16%). The results indicate that the project activities contributed to seed availability and knowledge on tree planting among farmers but could not address the core constraint of cost of inputs, land and labor. Covid-19 may have further exacerbated farmers' financial situation. Results of the household surveys are reported in more detail in Annex 7.4.



**Figure 4:** Multiplication efforts in project countries. *Top:* Farmer’s old nursery (left) and upgraded nursery (right) in Cambodia. *Middle:* Farmer seed source of *D. cochinchinensis* in Cambodia, second year after planting (January 2022). *Bottom:* Community members cleaning seed they collected from Chu Mom Ray National Park, Vietnam (left), establishment of a community nursery in the National Park’s buffer zone (right).

### 3.2 Outcome

*Indicator 0.1: At least 50% increase in number of designated in situ/ex situ Dalbergia conservation units across 4 countries (new for some countries or species)*

We have clarified the goal as the establishment of 23 new conservation units, across 3 countries. This has been successfully achieved with the designations of 22 conservation units within the newly extended timeframe. The low/diseased seed production in highly degraded populations has reduced options for establishment of both *in situ* conservation units but we were able to seize new opportunities arising from our work from the creation of provenance trials to set up *ex situ* conservation units (5 established, 6 pending).

*Indicator 0.2: At least 20% increase in forest-related income of 175 rural households in 3 countries (end year 3), through Dalbergia seed/seedling production and planting.*

This outcome target was met in Cambodia and Laos and partially in Vietnam. The indicator achievement was assessed through baseline and end-of-project surveys in the 7 target communities. Income increase was assessed as absolute increase and not in proportion to forest-related income as planned, because Covid-19 pandemic complicated data collection (for details, see Annex 7.3). In Cambodia, mean annual household income from seed and seedling sales almost doubled from US\$300 to US\$569 per family per year. This is a significant increase, considering that average household income in rural Cambodia is estimated at US\$7 per day or US\$2,555 annually. Additionally, when a local farmer's nursery in Pursat province was upgraded, employment opportunities for community members at the nursery almost tripled, from 20 person months (40% women) in 2018 to 57 person months (42% women) in 2020.

The proportion of households collecting *Dalbergia* seed in Laos did not significantly change (from 3% in 2019 to 4% in 2021), but the proportion of households selling *Dalbergia* seed or seedlings increased from 0% in 2019 to 16% in 2021 (Table 2). Sales of seed of other species also grew. Mean annual household income from seed sales in 2021 was US\$138, corresponding to 19% of the total forest-related income that year. Lack of *Dalbergia* seed sources near the project communities limited opportunities for seed collection, but community members produced and sold seedlings with seed that was supplied by the Forest Research Center. Part of the seedlings were used for restoring *Dalbergia* spp. populations within community forest and planting on farmland, to develop seed sources for future.

In Vietnam, new income from seed sales among seed collecting households was on average US\$43 annually. Additionally, 7 households obtained in average US\$43 of payments from the local National Park in 2021 for helping to establish and manage a *Dalbergia* spp. nursery at the Park headquarters as well as new conservation sites. The proportion of households involved in seed collection and seed sales rose from 0% in 2019 to 17% in 2021 (Table 2). This was a significant achievement, although the income-related target was not fully met.

*Indicator 0.3: Methods and training materials for conservation, multiplication and value chain development exist and >100 professionals and 175 rural households trained to use and adapt them to enable scaling out.*

Targets for training professionals were exceeded, with 173 people trained (31% women) (Table 3, Annex 7.3). Trainings focused on *in situ* and *ex situ* conservation methods and strategies (99 people trained, 34% women) and community-based seed sourcing and income generation (73 people, 26% women). Targets for training rural households were largely met, with 149 people trained (33% women), 85% of target, despite the fact that the Covid-19 pandemic prevented field activities and gatherings in communities for large periods of time since March 2020 (Annex 7.3). In total, 322 people received training during the project and 664 person days of training were delivered. [Reports of major training events](#) are available on the website of the Asia Pacific Forest Genetic Resources Programme (APFORGEN). [Guidelines for vegetative propagation of Dalbergia](#) are also available on the website, and training materials on seed marketing are provided in Annex 5 of this report. Examples of training materials for *in situ* and *ex situ* conservation, translated to local languages, are available in the Annex of the [training report](#).



**Table 3.** Training participants by country.

	Cambodia	Lao PDR	Viet Nam	Total
Professionals (%women)	54 (9%)	50 (28%)	69 (49%)	173 (31%)
Community members (% women)	46 (35%)	48 (29%)	55 (35%)	149 (33%)

### 3.3 Monitoring of assumptions

The assumptions are listed in the logframe; we do not repeat them here but comment on them and on monitoring of changes.

**Assumptions for project Outcome:** (i) The assumption on information has held true. (ii, v, vi) It is too early to fully assess; however, the level of engagement and participation of target groups indicates assumptions are likelihood to hold true. (iii) Community-based activities were limited by the Covid19 crisis which delayed the establishment of conservation units and mentoring activities. (vi) Overall, this assumption was too optimistic, as seed collection efforts in Lao PDR and Vietnam yielded less seed and with poorer germination rates than expected, due to small remaining population sizes, disease affecting seeds and adverse weather. This decreased the number seed collections and delaying establishment of provenance trials.

**Assumptions for Output 1:** Comments: The assumptions have held true.

**Assumptions for Output 2:** The willingness to set up conservation units and the availability of sites in each partner country has been very good as documented in all reports. The level of completion is indicated in Table 1. The designation for *Dalbergia* conservation units has already given new recognition to the importance of conservation activities and changed awareness, for example with the development of new tree nursery production at CMR National Park in Vietnam and seed collection permitted in the park for the first time, which is supported by a 5-year management plan. In Cambodia, a provenance trial was established with plans in place for its long-term maintenance. Similar trials are being finalised in Lao PDR and Vietnam, so the assumptions are still valid.

**Assumptions for Output 3:** These assumptions have generally held, expect for the availability of seed for establishing community nurseries (Assumption 3.5). In response, project activities have been adjusted to include establishment of seed sources and continue seed collections into years 3 and 4.

### 3.4 Impact: achievement of positive impact on biodiversity and poverty alleviation

The impact statement in the funding application was as follows: “Enhanced conservation and sustainable use of Rosewood genetic resources, for improved livelihoods and ecosystem services for thousands of rural people across ≥5 Mha of forest landscapes in the Mekong Subregion”. Through developing up-to-date distribution and threat maps as well as maps of conservation and restoration priorities (Annex 7.1), the project established the foundation for range-wide conservation planning for the 3 target species across six countries in the Greater Mekong subregion. The project results were used to update IUCN Red List Status of the species which were last assessed over 20 years ago. Listing of *D. cochinchinensis* and *D. oliveri* now as Critically Endangered is expected to stimulate further investments in conservation and restoration of the species (the assessment results will be published by IUCN in late 2022). The project also established 22 new *in situ* and *ex situ* conservation units for the three species across three countries on state-owned and private lands. Both the conservation assessments and the conservation units provide a model that can be expanded to new species and countries. In Cambodia Forestry Administration staff have expressed interest to apply the project’s approaches to other highly threatened and valuable native tree species such as *Aquilaria* spp. In Lao PDR the project influenced the development of the new National Forest Strategy to 2030 which includes targeted conservation actions on endangered tree species (Action Plan 2.3, draft May 2021).

The project improved livelihoods through increased income from sustainable use of the species (Annex 7.3). Household incomes from seed sales and employment opportunities in seedling production increased especially in Cambodia, where seed value chains already existed prior to project inception. Value chains for native tree seed and seedlings produced by rural households were also successfully established at the project communities in Vietnam and Laos where they practically did not exist before the project. This is a significant qualitative change even though the quantitative income targets were not met in the two countries. The regional nature of the project fostered exchange of information and experiences between countries and allowed the project teams in Laos and Vietnam to learn from and build on successes in value chain development in Cambodia. Farmer-owned seed sources for native, high-value species represent a new model of sustainable livelihood opportunities that can be expanded to other regions and species. The project also improved wellbeing more broadly, by fostering greater participation of rural men and women in natural resources management. Income that rural households received from forest user groups e.g. for tree planting and forest patrolling increased in Cambodia and Laos, indicating strengthening of the user groups (Annex 7.3). In Vietnam, local community members were for the first time allowed to collect seed from National Parks. Lastly, the project stimulated increase planting of *Dalbergia* sp. on farmlands and in home gardens in Cambodia, which improves household assets and provides potential future side income from seed sales.

## 4 Contribution to Darwin Initiative Programme Objectives

### 4.1 Contribution to Global Goals for Sustainable Development (SDGs)

The project's actions directly contributed to three SDGs

**SDG 15 Life on Land - Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss** and specifically its target *Take urgent and significant action to ... halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species*. The project's *in situ/ex situ* activities (see table 1, section 3) have conserved threatened populations of three *Dalbergia* species and their genetic diversity, for human use and adaptability to climate change, with development of techniques to make propagation easier. Increased local community capacity contributes to conservation of other native species through seed collection, nurseries and community planting across diverse land-use systems.

**SDG 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**. Research and training activities under output 3 (see section 3) have provided the basis for improving business models of community-based seed collection, sale and nursery work. Project outputs have resulted in increases in the communities' forest related income (Table 2), while wider uptake will spread these benefits to larger numbers of communities.

This links to **SDG 1** target of ensuring *all men and women, in particular the poor and vulnerable, have equal rights to economic resources*

**SDG 4 Quality Education - Specifically its target *By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development***, A range of capacity building activities during the project provided learning opportunities for 145 rural men and women (32% women), 173 government officials and other professionals (31% women) (Table 3), and 3 students (outputs 2&3, section 3, Annex 3 Standard Measures).

To **SDG4** through capacity building activities (see section 3, Annex 3 Standard Measures).

### 4.2 Project support to the Conventions or Treaties (e.g. CBD, Nagoya Protocol, ITPGRFA, CITES, Ramsar, CMS, UNFCCC)

The project contributed directly to the CBD and CITES. Our *in situ/ex situ*, research and community-based activities (section 13), directly supported CBD objectives at inter- and intra-species levels (CBD article 1): *conservation of biological diversity; the sustainable use of its components; and (also Nagoya) fair and equitable sharing of benefits arising out of the utilization of genetic resources*, through access to relevant technologies and funding. It followed CBD/COPs guidance: *... make use of native site-adapted species, giving attention to genetic variation within and among native species...*" (Decision XIII/5, Appendix I). Planting material choice is commonly driven by cost and availability, resulting in genetically limited germplasm, low native species diversity, and restored populations of compromised viability that neither contribute to species

conservation nor genetic diversity. Consequently, forecast returns on restoration investments are often unrealised. The project implemented guidance through practical solutions for diversity in endangered tree species community planting (Aichi targets 1,12,13,15,19). Project contributions were in line with partner country latest CBD National Biodiversity Strategy and Action Plans (NBSAP) as follows.

**Cambodia:** protect and recover threatened species (including tree genetic diversity) through *in situ and ex situ conservation*, needing to *identify and collect plant species ... requiring protection, reproduction and propagation* (our outputs 1&2) with the status of *all threatened fauna and flora improved significantly by 2020*. Actions for Aichi Targets include community-based sustainable forest management for biodiversity conservation, environmental protection, ... more employment and supporting incomes of local communities (our output 3).

**Lao PDR:** implement priority protection measures for seed sources of indigenous tree species, with the extinction of at least 5 priority species effectively prevented through better law enforcement and *in situ/ex situ conservation* (our outputs 1&2).

**Vietnam:** improve the quality and populations of endangered, rare and precious species (our outputs 1&2), promoting use of native species for forest enrichment and restoration within REDD+, developing long-term investment plans in protected area buffer zones and implementing a sustainable economic development model for households (our output 3). Priorities include enhancing the rights and capacity of local communities so that they actively participate in biodiversity conservation.

CITES has no stated objective, but recognizes “peoples and States are and should be the best protectors of their own wild fauna and flora; ... that international co-operation is essential for the protection of certain species of wild fauna and flora against over-exploitation ...” So the project complements enforcement of *Dalbergia* CITES restrictions. Target species are naturally distributed across the region and project activities will benefit from: collaboration between countries, local community involvement in conserving the resources, researchers’ experience from elsewhere in the world. Promotion of international cooperation in conservation and sustainable use of biodiversity are identified as solutions for implementation of NBSAPs and ASEAN’s regional action plan on CITES (2011-15).

We held exploratory discussions with the Knowledge Management and Outreach Services of the CITES Secretariat to provide input to their work on reviewing and developing management plans that aim to combine sustainable use with enforcement to prevent illegal rosewood trade. The project’s input has been to a workshop in Lao PDR run by the Secretariat and Lao CITES focal point( 19-23<sup>rd</sup> April, 2021) and also to 6th Session of the Intergovernmental Technical Working Group on Forest Genetic Resources (13-15<sup>th</sup> April, 2021). Outputs of these consultations are still pending.

### 4.3 Project support to poverty alleviation

The project’s beneficiaries were forest-dependent men and women in the project’s seven rural target communities. The project was successful in increasing their incomes from seed collection and seedling sales, especially in Cambodia, as reported in Section 3.2 (Annex 7.3). Compared to daily rural cash incomes of generally less than US\$7, seed and seedlings of *Dalbergia* species fetch high prices, ranging from approx. US\$100-250 per kg of seed and US\$0.50-1.00 per seedling in the project’s target provinces. The project supported the development of seed value chains by enhancing seed and seedling production capacities and training farmers in seed marketing, e.g. through using new marketing channels such as Facebook and radio and improved packaging (see [www.apfor-gen.org/resources/publications/publication/training-of-farmer-seed-suppliers-on-tree-seeds-marketing-cambodia](http://www.apfor-gen.org/resources/publications/publication/training-of-farmer-seed-suppliers-on-tree-seeds-marketing-cambodia) ). These marketing strategies allow farmers to connect with clients directly and reduce their reliance on middlemen, thereby increasing their financial share from seed/seedling sales. A pioneer farmer whose nursery was upgraded with support from the project, estimated that his income from seed and seedling sales increased by 25% as a result of better marketing strategy (Mr Sok Em, Pursat province, pers. comm.).

The project also contributed to broader wellbeing by helping to strengthen forest user groups, as they could provide more financial incentives to community members (Annex 7.4), and by granting new sustainable use rights to community members in National Parks in Vietnam.

#### 4.4 Gender equality

Household surveys revealed that very few women in the project communities are involved in collecting forest products for sale. Women reported not finding seed collection of *Dalbergia* spp. in the forest a safe activity, because of the remote locations, the need to climb the large trees, and because of dangerous wildlife such as snakes. However, the household surveys in Cambodia showed that women and men participate relatively equally in the collection of seed of other species such as *Acacia* spp. and *Sindora cochinchinensis* which can be collected from the ground after the seed is shed. The project supported the establishment of nurseries and grafted seed sources which provide more accessible income and employment opportunities for both men and women. The project met its target of rural women's participation in trainings on seed value chains in all three countries (29-35% women, against a target of 30%), indicating women's interest towards related income-generation activities. In Pursat, Cambodia, women made up 42% of employees at the local nursery after it was upgraded with project support. The established farmland seed sources do not yet yield seed and their impact on women's employment opportunities could not be verified, but it is expected to be positive due to much easier access and collection, compared to trees in forests.

The project met its target for the participation of female professionals in training activities (31% of trainees were female, target 30%). However, women's participation varied widely between countries, from 9% in Cambodia to 49% in Vietnam. Gender norms and historical imbalances prevent women's involvement in the traditionally male-dominated forestry sector.

#### 4.5 Programme indicators

- **Did the project lead to greater representation of local poor people in management structures of biodiversity?**

Local poor people were involved in the project including existing forestry community committee recognized by law but the project did not have an explicit goal of representation on management structures. Local poor people were empowered through training on seed value chains and monitoring of endangered trees associated with conservation units as well as the development of sustainable nursery and seed production. Many of these engagement activities were directed at poverty alleviation and the establishment of conservation units creates a soft mechanism for local poor people to contribute to management structures. Another example include permission being granted to farmers to collect seed in Vietnam (National Park).

- **Were any management plans for biodiversity developed and were these formally accepted?**

Formal management plans were developed for conservation units in Cambodia and Vietnam (annex 7.2), have been formally accepted by the respective authorities.

- **Were they participatory in nature or were they 'top-down'? How well represented are the local poor including women, in any proposed management structures?**

Some are participatory in nature, e.g. local communities received training in conservation and seed collection associated with the monitoring of conservation units. Others were more top-down such as permission being granted to farmers to collect seed in Vietnam (National Park).

- **How did the project positively influence household (HH) income and how many HHs saw an increase?**

The project nearly doubled annual household incomes from seed collection and seedling production in Cambodia, and created new income streams for households from these activities in Laos and Vietnam, where seed value chains did not exist in the target communities before the project. Proportion of benefiting households (17%) among sampled households did not increase in Cambodia, but the average income obtained by participating households increased by 89% compared to baseline. Proportion of benefiting households in Vietnam rose from 0% at baseline to 17%. In total 165 households were sampled at the end of the project.

- **How much did their HH income increase (e.g. x% above baseline, x% above national average)? How was this measured?**

See above

#### 4.6 Transfer of knowledge

The project enabled two students to undertake a Ph.D., one is completed and one is close to completion. One student was female from a developing country (Thailand-Swiss nationality) and the other was male from a developed country (Hong Kong). Their training was supported financially by other sources but the project provided them with the materials and data to conduct their analyses. In addition, an undergraduate student (female) from a developed country (United Kingdom) carried out their undergraduate research project on drought stress using materials from the project (*D. cochinchinensis* and *D. oliveri* plants).

#### 4.7 Capacity building

A key staff member from Cambodia (Male) has been promoted 2021 to: 1) Head of the Forest Development and Botanical Research Center of IRD; 2) Coordinator of the project "Establishment of High Value Tree Species Breeding Center in Cambodia".

### 5 Sustainability and Legacy

Initiatives to promote the project's activities have varied across partner countries, but have centred on efforts to ensure sustainability of the project's varied initiatives beyond the project life (e.g. maps and information on threats to *Dalbergia*, CUs, provenance trials, seed production stands, nursery activities, training materials). Long-term availability of project information and outputs is covered in Section 13 below. Lao PDR is revising its National Forest Strategy, with Mr Chaloun Boounithiphonh from our Darwin project is a member of the revision team. He argued for the strategy to highlight the need for specific conservation strategies for key species and although not currently publicly available, this is now incorporated in the draft revised strategy.

In Cambodia the farmer nursery and seed sources will be sustainable beyond the project, given the income stream from seed and seedling sales. Both the nursery and seed sources are established on the farmer's land such that there is no issue of land tenure, which has been identified as a critical factor in the loss or maintenance of conservation units established under previous initiatives. Likewise, the *D. cochinchinensis in situ* conservation unit in Kampong Thom province, is located in a well-established community forest with secure land tenure. The project provided basic tools and financial assistance to the community to increase the frequency of patrols, resulting in a significant reduction in illegal cutting of *D. cochinchinensis* in the past year. A project meeting in April 2021 (Q1, Y4) is focussed on considering factors and actions to ensure sustainability of all the project's new conservation units.

Other project legacies include: 1) inputs to the updated Red List assessment for the three *Dalbergia* species, which highlight an increasingly threatened status of the species and hopefully inspire further actions and investments for their conservation and sustainable use; 2) genome sequences and genome-wide data on genetic variability indicative of population structure and adaptability to changing climates.

The project team submitted several project proposals for follow up projects between 2018 and 2022, as reported during previous annual reports, but these were unfortunately not successful. The team is currently developing a proposal for Laos, for funding by the ETH Research and Development Grant, Switzerland. Additionally, a team led by Bioversity International was awarded a 2-year Darwin Initiative Capability and Capacity grant in March 2022, to further refine the methods applied in this project and apply them to support the use of native tree species in land restoration in four South and Southeast Asian countries. A small grant is being prepared for submission to the National Geographic Society to expand the eco-physiological research to compare different provenances in response to drought (see Hung et al. 2021, Annex 5).



**Figure 5.** Maximising land productivity and improving short-term income from rosewood with other planted seed sources. Top left: Farmers in Pursat province plant agricultural crops in the *D. cochinchinensis* seed orchard to generate additional income. Top right: Close view of the established agricultural crops (ground peanut, watermelon, and pumpkin). Bottom: Agroforestry experiment with *Dalbergia* spp. in Laos. *Dalbergia* is planted with fruit trees and with rice, banana, and beans in years 1 and 2.

**6 Lessons learned**

- A. Monthly meetings with project partners from beginning of the pandemic.** Zoom meetings were crucial to maintain a good level of communication, monitor unexpected changes, and adjust plans accordingly. We found that alternating meetings on administrative issues and on technical topics was both effective and appreciated by the team.
- B. Development of online meetings increases project impacts.** We ran Outreach Events in years 3 and 4 of the project, along with our annual workshop in year 3. This facilitated wider participation of potential end-users and collaborators.
- C. Choice of people/groups to work with.** Identifying and working with groups/individuals who are already active on the ground or identify with the project’s aims/activities will ensure the success and efficiency of the project’s activity. This has been particularly successful in Cambodia for setting up a seed orchard and propagation area, as well as in Vietnam where a National Park authority supported the development of a new nursery and allowed seed collections by local people in response to the project.
- D. Project management workload.** Project leader time was set at 20% in the budget but the actual time spent is closer to 30-40% given that there are partners in 3 developing countries

and 2 others and the extent of reporting that is required by Darwin. Project leaders should plan substantial time and consider using a project management function (see E).

- E. Administration of Darwin Initiative project has proven time consuming and complex.** The complexity arises because of working in a multilateral context, with variability in seasonality, ways of working, policies for material exchange, fund transfers. Future projects should plan for more support staff / project manager time to help with planning, administration and reporting.

### 6.1 Monitoring and evaluation

There was one major **change to the project design**, which was the exclusion of the Thailand partner due to their inability to participate in the planned work under the conditions of the funding. The change was approved by the DI administration (via a Change Request); the changes included establishing more conservation units elsewhere (increase in Lao PDR) and redistribution of funds to other partners in the Mekong sub-region. Minor changes (approved by the DI administration via a Change Request) were made to: 1) clarify the definition and an adjustment to the number of conservation units across the project; 2) the inclusion of seed orchard establishment in outcomes supporting poverty alleviation.

There were three meetings of the project’s Monitoring and Evaluation Advisory Group, in March and September 2020, and March 2021. The discussions and recommendations focused on the impact pathway as the means to achieve the project outcomes (see yr 2 and 3 annual reports), which led to a session on impact pathways at our yr 3 annual workshop, where we clarified the recipients, the means to reach them, and developed a more detailed mapping of impact pathways. Other recommendations were aimed at strengthening outcomes such as plans for scaling through future funding, gathering information on perceptions, and communication with other projects in the region. Forming the advisory group and holding meetings proved particularly challenging and the discussion were somewhat redundant at each meeting; therefore, it suggested that future projects consider holding a first meeting at the mid-course and a final meeting in the last quarter of the project.

External evaluations of the work are obtained through the peer-reviewing of publications and presentations at conferences, including pending publications.

### 6.2 Actions taken in response to annual report reviews

Most issues raised by the reviews have been addressed and resolved. We provide an update on outstanding issues and how they are being addressed with the partners.

No	Comment from Annual Report Reviews	Actions taken / response
1	Reviews remarked on problems with fund transfers from Oxford University in years 1 and 2. The problems continued throughout the project and submission of Actuals reports in years 2 and 3 were several months late.	<i>Project lead took over financial management from yr 2 but had no control over reporting. Oxford University’s problems persisted due to high staff turnover and problems in yrs 2-3 linked to the pandemic (delays, errors on amounts). In yr 4, requests from the project lead improved financial support at Oxford for project-end management.</i>
2	Preparation of more funding proposals to support activities post-project proposals	<i>Supplemental funding request were made in yr 2 but were not successful. In yr 4, a successful Darwin application led by Bioversity Alliance involves similar work in conservation of tree species in neighbouring countries (see section 5 of this report). Other funding applications are in preparation (section 5).</i>
3	Consider exchange site visits between partner countries if surplus funds are available (Thai portion)	<i>Engagement with the Thai partner was attempted but was not successful. However, we found another Thailand organisation (Botanic Garden) was willing to provide samples to support work on genetic diversity and vulnerability gaps.</i>

## 7 Darwin identity

The Darwin Initiative logo is always used/displayed in the banners/backdrops of trainings and workshops, as well as in report covers and printed dissemination materials (see Annexes). This can also be seen in banners developed in the project (see Figs 1, 4 and 5 of this report) for new nurseries established by the project in Cambodia, Lao and Vietnam and on the information board for the new provenance trial in Cambodia.

Biodiversity International developed a website for the project which was launched in June 2019: [www.apforgen.org/activities/conserving-dalbergia/](http://www.apforgen.org/activities/conserving-dalbergia/). The website sits within the website of the Asia-Pacific Forest Genetic Resources Programme, through which the project was developed and which ensures continuity for communications beyond the duration of the project. As mentioned in section 12, the genesis of the project was through APFORGEN, but at the same time the Darwin project is seen as a distinct entity. The site includes the Darwin Initiative logo and a link to its website. Reports of project workshops and trainings, also with the relevant logos, are published on the same website.

Project activities were also publicised through numerous tweets by APFORGEN (@APFORGEN), the Alliance of Biodiversity International and CIAT (@BiovIntCIAT\_eng) and Biodiversity researchers Christopher Kettle (@██████████) and Tania Kancharanak (@██████████ Oxford Plant Sciences/Biology (@OxfordPlants) and through OxTalks (<https://talks.ox.ac.uk/>).

## 8 Impact of COVID-19 on project delivery

The COVID-19 pandemic has caused delays to our field activities in the Mekong and postponed events involving both local and international travel. We revised our project timelines including a continuation of activities into a fourth year, postponing our participation in international symposia, with budgets adjusted accordingly (via Change requests in yr3 and 4). The level of COVID-19 infection in the Mekong has gone through several waves associated with strict and unpredictable lockdowns causing delays to field work in Cambodia, Lao PDR, and Vietnam. Longer term restrictions on international travel have postponed some events by up to 24 months and prohibited travel into or from the Mekong region for workshops or to support household surveys, among others. Lockdowns, working from home and other restrictions have been very disruptive and significantly decreased the productivity of staff members but this is difficult to quantify.

The latest Change Request in Q1 of year 4 set out alternative plans to meet our final objectives and present adjustments to the budget. The affected activities included an end of project workshop, which we had planned to hold in Cambodia, and regional outreach workshops in the Mekong sub-region; however, these were replaced with an online outreach event attended by 47 participants and other outreach activities with reduced restrictions and uncertainty of face-to-face activities. The plan also addressed delayed activities, including finalising the establishment of conservation units (CUs), provenance trials, household surveys, and work on seed/seedling production value chains in the Mekong partner countries

We have ensured the health and safety of project staff by strongly encouraging project partners to respect local restrictions as applicable, which includes avoiding face-to-face project meetings. To the best of our knowledge, the project will not directly assist with the response to the pandemic but it could indirectly reduce future risks of pandemics, due to its focus on the conservation of forest genetic resources to support restoration including habitats for wildlife.

From the beginning of the pandemic, we have held monthly meetings with project partners to monitor issues and address challenges as they arise. The meetings doubled in frequency compared to before the pandemic and the use of Zoom has improved the quality of communications. We ran our 2020 annual workshop as an online meeting with three sessions including an online outreach event with 22 participants (for details see Sections 3 and 11). We expect that these new ways of working will continue in the future and reduce the need of international travel for symposia and workshops.



## 9 Finance and administration

### 9.1 Project expenditure

Project spend (indicative) since last annual report	2020/21 Grant (£)	2020/21 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)	██████████	██████████	-18.78%	A
Consultancy costs	██████████	██████████	-40.55%	B
Overhead Costs	██████████	██████████	-12.31%	C
Travel and subsistence	██████████	██████████	-23.09%	D
Operating Costs	██████████	██████████	+1.73%	
Capital items (see below)	██████████	██████████	0%	
Others (see below)	██████████	██████████	+15.88	F
<b>TOTAL*</b>	71,246.00	60,312.41		

#### Comments for significant variances

A, There was a slight decrease staffing due to the pandemic restriction on operations

B, There was a decrease in consultancy due to the pandemic restriction on operations

C, Reduced overheads resulted from decreased staffing and consultancy

D, Travel to field sites and workshops/symposia was decreased due to the pandemic restrictions

F, This is largely due to unforeseen upgrade of field internet

**\*Important note:** the total cost reported here does not include the internal audit (budget of £1500, not yet incurred).

Staff employed (Name and position)	Cost (£)
John MacKey – Oxford PI	██████████
Hoa ,Tran (conservation Director)	██████████
Dung, Tran (Field Co-ordinator General FC	██████████
Hop Pham (Trainer on the field)	██████████
Tuong Van, Nguyen(trainer on the lab for tissue culture)	██████████
Hang, Nguyen (coordinator on conservation unit and seed collection)	██████████
A Uak (contractor on the nursery care)	██████████
Mr Bansa Thammavong Deputy Director of Forest Research Center, Project coordinator	██████████
Mr Chaloun Bounithiphonh - Dept. of Forest Ecology & Environmental Research Section, project coordinator's Assistance	██████████
JALONEN, Riina - Scientist	██████████
GAISBERGER, Hannes - Associate Scientist	██████████
Mr Sreng Syneath -Project Assistant cum accountant	██████████
<b>TOTAL</b>	██████████

Capital items – description	Capital items – cost (£)
N/A	
<b>TOTAL</b>	0

Other items – description	Other items – cost (£)
Local Postal services Accounting and admin services Special services, transferring seeds Improvement of internet connection on field Financial services Research Support Services for Riina Jalonen and Hannes Gaisberger	
<b>TOTAL</b>	

### 9.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)
Ph D student (co-funded by Bioversity)	
PhD student (Oxford) (funded by BBSRC)	
Volunteer work by D Boshier in Y4 after retiring from Oxford (15%)	
<b>TOTAL</b>	

Source of funding for additional work after project lifetime	Total (£)
<b>TOTAL</b>	

### 9.3 Value for Money

The project has delivered an extensive program of work combining diverse activities and outputs on the ground in the Mekong sub-regions, publications, trainings, reports, guides for dissemination in local languages, events with international reach, and a multi-faceted sustainable legacy. The legacy includes conservation units, new methods, improved awareness, and competency of many individuals including both professionals and members of poor households.

The funds were dispersed and managed according to agreed budgets, terms and conditions, and all variances, although significant over in some case but not representing large amounts, were explained by slight readjustments to the work plan to optimise outputs. All changes were

approved by the funder via formal change requests. Financial accounting at Oxford will be audited.

Many of the project partners have gone much beyond the time allocated in the budget to ensure project management and delivery, and to meet the reporting requirements, or continuing to work on the project after retirement (D Boshier, valued at £[REDACTED]). The project outputs were leveraged by the recruitment of two PhD students (valued at £[REDACTED] in total) who have and will publish the results of work done within the project.

**10. OPTIONAL: Outstanding achievements of your project during the (300-400 words maximum). This section may be used for publicity purposes**

I agree for the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

- The project surpassed its training objectives with a total of 173 professionals and 149 individuals from communities including members of recognized forestry communities, with more than 30% women (annex 7.3). We produced diverse training materials, workshop reports, training guides, and technical guides, many of which are in local language, which represent a significant legacy for end-users and stakeholders in the different partner countries (e.g. see annex 5, annex 7.5)
- The project has established 22 new conservation units in the region and 6 more are expected for the Summer 2022 (Output 2). This doubles the number of existing units in the partner countries despite significant challenges due to ongoing illegal logging, which is reducing available populations, low physiological quality of seeds, and covid restrictions. We have been able to meet our goal partly due to our flexible approach and the establishment of additional *ex situ* units, as a crucial response to disappearing trees in forests throughout the area.
- The seed production capacity has increased because of the project's activities. Although it is too early to measure the capacity, the project partners have created lasting seed production systems. These include a seed orchard through a partnership with a farmer in Cambodia and an agreement for seed collection with a National Park in Vietnam, both of which were added to our initial plans.
- Benefits were measured for poverty alleviation when comparing initial and final household surveys. These benefits are expected to impact women in a relatively high proportion based on their involvement in community training (29% to 35%, depending on the country) (annex 7.3).
- The research in landscape genomics has developed highly novel resources to sustain knowledge creation into the future, in addition to filling existing knowledge gaps. These resources include among the first genome and transcriptome assemblies in *Dalbergia*, and the first large-scale genome-wide analysis of population diversity and adaptability to changing climates.