Intervention options for strengthening farmer participation in Rosewood seed supply chains in Cambodia

Supporting seed production by small private seed suppliers improves seed production and income opportunities

Conserving Rosewood genetic diversity for resilient livelihoods in Greater Mekong *is a regional initiative implemented in three countries (Cambodia, Laos, and Vietnam) from July 2018 to December 2021.*

National project partners are the Institute of Forest and Wildlife Research and Development (IFWRD, Cambodia), the National Agriculture and Forestry Research Institute of Laos and the Vietnamese Academy of Agricultural Sciences.

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Forest and landscape restoration commitments stimulate demand for native tree seedlings in rural areas and provide opportunities for local communities to participate in seedling production and generate income. However, seed sourcing for restoration is often not designed optimally to support and sustain community participation. Quality of marketed seed is also a common concern, as seed collectors and suppliers lack knowledge and tools for collecting genetically diverse seed

Here we describe interventions that can support or hinder seed supply for native species and community members' participation in supply chains, using examples from field research in Cambodia and literature. The evaluated interventions are developing community nurseries, networks of small private seed suppliers, community forest protection initiatives, facilitating contracts on seed tree conservation with tree owners, establishment of private seed sources, and quality control mechanisms.

The interventions were selected for their potential to address supply and demand constraints in native tree seed markets in Cambodia, as identified by market chain actors (Table 1). We evaluate the interventions based on how they support market access, access to production inputs and capacities, gender equity and social inclusion, seed production, seed quality and conservation of natural seed sources.

Figure 1. Villagers patrolling a community forest to protect rare Burmese Rosewood *(Dalbergia oliveri)*, Cambodia. Credit: IFWRD.

Table 1: Constraints in tree seed supply and market chains in Cambodia as identified by chain actors.

Constraint	Community Forestry groups	Small seed suppliers	Forestry Administration
Output markets			
Lack of information on buyers	x		
Few buyers	x		
Difficult to find buyers as there are many seed sellers			x
Concerned of market risk (lack of customers)			x
Lack of price information		x	
Low price although seed is difficult to collect	x	x	x
Some buyers owe money		x	
Production			
Lack of knowledge on seed collection	x		
Difficulty of collecting seed from tall trees	x		
Seed pods are infested with insects	x		
Seed trees have ants	x		
There are poisonous snakes in seed source areas	x		
Lack of knowledge on seed storage	x	x	
No suitable land for building nursery	x		
Nursery is small		x	
Lack of knowledge on nursery management	x		
Lack of water in the dry season for raising seedlings			x
Pest and disease problems in nursery		x	x
Lack of funds for maintaining seedlings			x
Lack of funding to involve communities in activities			x
Lack of participants due to outmigration			x
Input supply			
Lack of material to meet the demand	x	x	x
Seed trees in the community forest are disappearing, especially for *D. oliveri*	x	x	
Irregular seed production			x
Lack of information on seed sources			x
Lack of seed of preferred origin			x
Criteria for selecting seed trees are unknown			x
Poor seed quality			x
High price by suppliers			x

Study methods in brief

The analysis presented here is based on surveys and interviews of actors in tree seed supply chains in Cambodia between January 2019 and April 2021. In total 13 supply chain actors Kampong Thom and Pursat provinces were interviewed about their activities, challenges and opportunities in supply chains. Fifty households from two communities were surveyed about their participation in supply chains and tree planting and related income. Community members also participated in participatory exercises to understand the challenges and opportunities they face in supply chains. Lastly, a survey was carried out among 25 national level actors from public, private and civil society sectors. Results were compared with findings from literature.

Community forestry groups and small seed suppliers in the two provinces received technical support on seed collection, seedling production and marketing as well as seed funding and patrolling and nursery equipment from the Institute of Forest and Wildlife Research and Development between 2019 and 2021, with funding from the UK Darwin Initiative [3].

Context

Cambodia has a mixed history of forest use. Decades of timber harvesting and poor forest governance have reduced natural populations of native tree species and limited the control of and access to natural resources by rural communities. Policy and strategic decisions around forest and landscape restoration have, however, in recent years resulted in extensive tree planting efforts on communal and smallholders' lands, and vibrant tree seed markets have emerged, which offer job and income opportunities for rural people. Important developments in this process include the allocation of government funding for tree planting on communal lands, the Forestry Administration's decisions to purchase seed from community forestry groups and small-scale seed suppliers, and donor support for capacity development projects. Over 330 community forests have been designated in the country since 2003 [1]. Cambodia also lacks a quality control mechanism for tree seed that could improve seed quality but also hinder the participation of small suppliers in seed markets.

Although tree planting is predominantly motivated by habitat restoration and species conservation, the planting efforts focus on native high-value timber species such as Siamese and Burmese Rosewood (*Dalbergia cochinchinensis* and *D. oliveri*). Demand for tree seed grew by almost six-fold between 2003 and 2015 when an estimated 12.8 million seedlings were planted across the country [2]. A clear majority of the seedlings at approximately 70% were of native species, with Siamese Rosewood being the most planted species. The remaining 30% of seedlings were of exotic plantation species such as Acacia and Eucalyptus.

Figure 2. *Right:* Remnant Siamese Rosewood *(Dalbergia cochinchinensis)* on a farmland, Kampong Thom, Cambodia. *Left:* Collection of seed of Burmese Rosewood *(Dalbergia oliveri)* in a natural forest. Credit: R.Jalonen/ Bioversity Int.; IFWRD.

Intervention options

Establishment of community nurseries

Community nurseries are a common approach in forest restoration projects and programmes. However, in Cambodia, only one of the eight surveyed communities operated a community nursery which had been established during a donor-funded project in 2010. The nursery has helped community members access seed markets: planting material is sold to more diverse buyers than what individual seed collectors do, and the nursery group also receives a markedly higher price for seed than individual collectors (Table 2). Community nurseries can improve farmers' access to nursery equipment and skills training, as support can be targeted to the groups [4]. Community nurseries also offer opportunities for vulnerable social groups to participate in seedling production to generate income, as investment and operation costs are shared and often sponsored. However, groups may be dominated by powerful individuals, and principles for sharing revenue are not always clear [4, 5].

The surveyed community nursery produced approximately 500 seedlings of *Dalbergia cochinchinensis* per year, as well as seedlings of other native species. These volumes are low compared to small private nurseries run by individual farmers in the same area (Table 2). Uncertainty of income and group dynamics may affect the productivity of community nurseries, as people may be reluctant to invest effort [4, 5].

Community nurseries are likely to obtain seed from several seed collectors who may collect in different parts of the community area. Seed and seedlings from community nurseries can, therefore, be more genetically diverse and of better genetic quality than seed collected by independent collectors [6]. As other types of trainings, trainings on seed quality can also be easily targeted at community groups. Community nurseries can provide added motivation for conserving and enhancing seed sources in the community forest and other communal lands.

Supporting networks of small private seed suppliers

While community nurseries are uncommon in Cambodia, several farmers have established their own small nurseries. In total 8 such small operators were identified in the two surveyed communities in Kampong Thom and Pursat provinces. Evidence from other countries suggests that networking helps small nursery operators access markets and benefit from economies of scale. They may, for example, take larger orders together and share information on the locations of seed trees [4]. Individual network members may specialise on specific species to improve production efficiency. Networks of private suppliers help reduce problems of free riding and unequal benefit sharing associated with community nurseries [4].

Table 2. Seed and seedling trade for *Dalbergia cochinchinensis* in Kampong Thom and Pursat provinces in Cambodia in 2019. Volumes are average per respondent or per Community group, per annum.

	Seed bought, kg	Seed sold, kg	Purchase price, US$	Selling price, US$	Seedlingsproduced	Seedlings sold	Selling price, US$
Small-scale business (8)	n.d	14	175	215	13,933	9,408	0.74
Community forestry group (8)	-	<2.0	-	143	500	500	0.75
Independent seed collector (10)	-	n.d	-	100		-	-

[a] Pricing depends on seedling age (3 to 24 months)

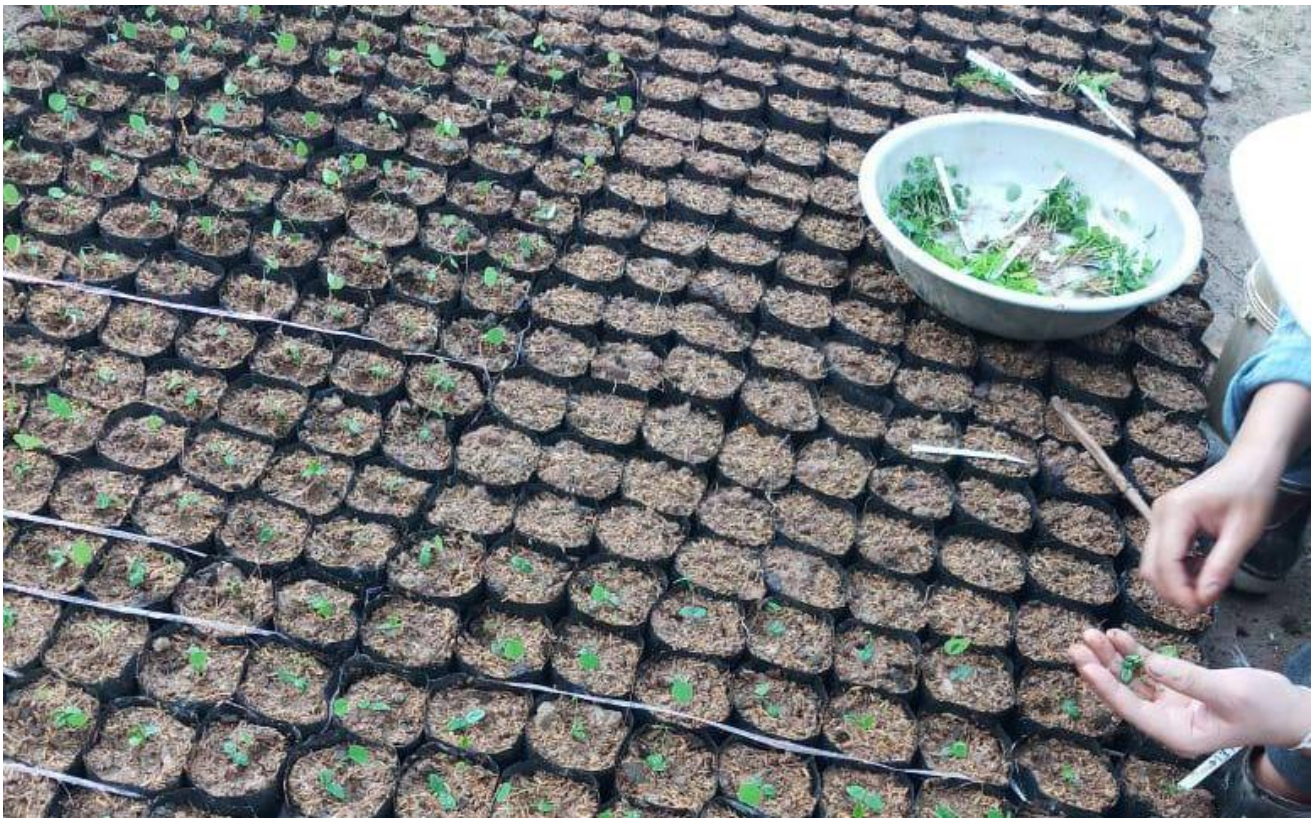

Figure 3. Woman prickling of seedlings in a local nursery, Pursat, Cambodia. Credit: IFWRD.

We did not find evidence of nursery owners in Cambodia collaborating in production or marketing, but several value chain actors recognised the benefits of networking. Community members suggested that producers collaborate to coordinate pricing, so as to obtain better prices. Networking can also help strengthen producers' capacities through farmer-to-farmer extension [4]. Institute of Forest and Wildlife Research and Development has collaborated with a pioneer farmer from Pursat province to train other farmers in seed pre-treatment, seedling production and grafting. When small seed suppliers in Pursat province received training on seed production and marketing, their average income from seed and seedling sales almost doubled from US$300 per year to US569 per year (Table 3).

Individual suppliers need financial resources to initiate production, which hinders the opportunities of vulnerable social groups to enter production. With one exception, all private seed suppliers and producers identified in this study were male. The one well-to-do female seed supplier did not collect seed herself but traded seed she bought from other collectors in her village. Female community members considered existing seed sources in forests difficult to access, due to their remote location, dangerous wildlife such as snakes and the need to climb trees to collect Rosewood seed. These factors were a major constraint for their participation in seed production. However, female community members reported collecting seed of other tree species for which seed is collected from forest floor after shedding. Nursery operations are more feasible as economic activity for women than seed collection but require access to inputs and financial resources.

Networking between small suppliers has the potential to increase seed production through easier access to skills training compared to independent producers, and more direct and certain benefits to participating producers compared to community nurseries [4]. Independent producers in Cambodia produced in average clearly more seedlings than the studied community nursery (Table 2). Seed quality may also improve through networking and training, and producers may compete with quality if there is demand for quality material. Networking indirectly supports conservation by creating demand for seed and seed sources.

Community forest protection programmes

Some of the largest remaining seed sources for Rosewoods in Cambodia are found in community forests. Supporting community forestry programmes e.g. around forest restoration, patrolling and forest fire management can, therefore importantly contribute to conserving seed sources for these and other threatened tree species. When members of a community forestry group in Kampong Thom province were provided training on seed collection, seedling production and marketing, seed sales did not increase but tree planting did. This suggests that group members prioritised restoring Rosewood populations within the community forest over selling seed or seedlings to outsiders. Interviewed community members reported threats of illegal logging to Rosewoods within their community forest, highlighting the importance of patrolling. Forest protection activities help maintain and restore viable species populations and, therefore, contribute indirectly to seed quality. Data about the impacts of patrolling on illegal activities is not available but should be collected to help assess and recognise the role of community-level efforts. As with other types of group activities, supporting community forestry programmes helps deliver training to community members.

Patrolling is typically carried out by men but seedling production and tree planting provide opportunities also for women. Members of community forestry groups often receive payments for carrying out forest protection activities (Table 3), and compensated activities should ideally include activities that are feasible both for men and women to carry out. Inclusive decision-making and benefits around participation opportunities and payments should be supported. Boosting forest-related income is crucial to sustain forest protection activities in the short and long-term [7].

Contracts with seed tree owners

Remnant trees on farmlands are an important source of seed for Rosewoods in Cambodia, given that most natural seed sources have disappeared from the country's landscapes. Providing incentives for tree owners to maintain their trees supports both resource conservation and seed production. Reliable supply of seed can encourage investments in seed production. At the same time, interests of tree owners (typically larger land owners) and seed collectors both need to be met. Small seed producers in Kampong Thom and Pursat provinces reported having to pay fees to tree owners for seed collection, up to US$50 per tree. Some collectors reported that advance payments were required which was challenging for them as they would only receive income once seed were sold. Brokering or modeling contracts by government or civil society groups can help foster more equal and appealing contract terms for both parties. Impacts on seed quality depend on contract terms. Collection fees may discourage collecting from several trees when every tree has to be paid for separately. Fostering payments per amount collected can encourage collection from more trees and improve seed genetic quality.

Table 3. Development of forest-related household incomes after the provision of technical and material support for seed collection, seedling production, and marketing in Kampong Thom and Pursat provinces, Cambodia, from 2019 to 2021.

Indicator	2019	2021 (change %)
% of households collecting seed of Dalbergia spp.	13	20 (+56%)
% of households selling seed of Dalbergia spp.	17	17 (-4%)
Mean annual income from tree seed sales, US$	300 ± 373	569 ± 971 (+89%)
% of households obtaining payments from forest user group	59	73 (+23%)
Mean annual income from forest user group, US$	32 ± 40	57 ± 75 (+77%)

Supporting the establishment of private seed orchards

Lack of seed sources is a major constraint to small suppliers of Rosewood seed and seedlings in Cambodia (Table 1). Establishing private seed orchards and encouraging tree planting on farmlands and in home gardens helps improve producers' access to seed and increase production, which in turn improves market access. Although provincial Forestry Administration purchases seed and seedlings from smaller suppliers, the Central Forestry Administration prefers suppliers that can supply larger volumes and pays substantially higher price for seed and seedlings. Seed orchards established through grafting start producing seed within 3-4 years from planting, compared to trees raised from seed which take several years longer. Seed collection from trees kept short by pruning is faster and safer than from large trees. Monitoring of seed ripening and timely collection are also easier at farmland seed sources than in forests which contributes to better seed yields, because fruiting season of Rosewoods is short and its timing varies between years.

Impacts on seed quality depend on the genetic diversity and quality of planting material.

Remaining natural populations of Rosewoods are typically small and seed is often collected from remnant trees, so seed quality is generally not high. There is a risk of seed orchards being even less diverse than remnant natural populations if the grafted plants are established from material from just a few trees. Farmers need training on genetic aspects to select and use many parent trees in establishing seed orchards (ideally 25-30 unrelated trees in equal proportions) [8]. Such orchards would then also contribute to the genetic conservation of threatened Rosewoods. Availability of parent trees is a constraint especially for Burmese Rosewood (Table 2). A pioneer farmer who established a seed source in Pursat province in 2021 could only obtain grafting material from 9 trees.

Seed orchards need relatively large land area, typically at least 0.5 ha, making them feasible only for larger landowners. Farmers also have to be able to cope with reduced income in the first years after establishment, until the trees start to produce seed. Agroforestry can provide income in the transition period, with crops planted in Rosewood seed sources including peanut, pumpkin, and watermelon. Compared to forest seed sources, planted seed sources on farmlands can provide job and income opportunities for women due to easier access.

Figure 4. *Right:* Farmer grafting Siamese Rosewood *(Dalbergia cochinchinensis)* for his seed source in Pursat, Cambodia. *Left: T*wo-year old grafted plants at the seed source. Credit: IFWRD.

Quality assurance mechanisms

Lack of seed quality assurance is a growing concern among market chain actors in Cambodia (Table 1). Many market chain actors expressed how seed quality concretely affected their decisions on seed and seedling purchases. Lack of quality assurance can reduce willingness to pay for seed and seedlings when buyers demonstrate awareness of seed quality, and they may resort on sourcing seed themselves instead [9]. In such situations, investing in seed quality can help producers obtain better prices. Quality assurance would likely also contribute to seed availability in medium to long term, as planting trees for seed production and collecting seeds from planted populations are already common in Cambodia. However, there is a risk that enforcing quality assurance mechanisms pushes small suppliers out of seed markets, as has happened in other countries [5, 10]. Institute of Wildlife Research and Development under the Forestry Administration has assumed a strategy where developing seed markets and improving small suppliers' access to markets is prioritised over strict quality control. Quality improvement measures can be introduced at a later stage once markets are vibrant and opportunities develop for suppliers to specialise and compete based on demand. This strategy appears to be paying off, as seed markets for native species in Cambodia are already fairly developed, especially compared to neighbouring countries where such markets are clearly lacking.

When quality assurance mechanisms are introduced, they need to be accompanied with continued capacity training for suppliers, to allow them to improve quality rather than excluding them from markets [11]. While the tree planting programmes in Cambodia are funded mainly from government budgets, capacity development on seed production and seed quality is mainly project-funded, and ensuring its continuity is important to support further development of seed markets and their contribution to both productivity, livelihood and genetic conservation objectives.

Conclusion

The strengths and weaknesses of the evaluated interventions are summarised in Table 4. Interventions focused on supporting seed production by small private seed suppliers likely improve seed production and market opportunities the most. In the initiative that this study is based on, community-based interventions were not effective in promoting seed production

Table 4. Summary of the evaluated interventions for improving seed production and farmer involvement in seed supply chains.

	Socio-economic			Ecological/technical		
Intervention	Market access	Access to inputs	Social inclusion	Seedling production	Seed quality	Conservation of natural seed sources
Establishing community nurseries	+	++	+ / -	+	+	++
Developing networks of producers	++	++	+ / -	++	+	+
Community forestry (restoration, patrols)	0	+	+	0	+	++
Contracts with seed tree owners	+	++	+	+	+ / -	++
Private seed orchards	++	++	+ / -	++	++	0
Quality control	+ / -	+	-	+ / -	+	+

++: Positive (high), +: positive (medium), + / - : mixed, - : negative, 0: no impact

or related incomes. Their impacts are constrained by unclear responsibilities and benefit-sharing within groups that discourage members from investing time and effort in group activities. Communal interventions may improve opportunities for vulnerable social groups to participate in income generation activities as initial investment costs are shared, but group dynamics and power relations need attention and may not always work in their favour.

Communal interventions contributed positively to the protection of seed sources and tree planting that were not focused on income generation. A combination of collaborative interventions and interventions targeting private actors will most likely yield both conservation and livelihood outcomes. Most interventions had mixed implications for gender equity and social inclusion, highlighting the need to consider these aspects in intervention design and targeting to reduce poverty in its different forms.

Figure 5. Member of a community forestry group patrolling Siamese Rosewood in the community forest, Kampong Thom, Cambodia. Credit: R.Jalonen/Bioversity Int.

Authors:

Dr Riina Jalonen
Bioversity International, Malaysia
r.jalonen@cgiar.org

Dr So Thea and Mr Sineath Sreng
Institute of Forest and Wildlife Research and Development, Cambodia

https://alliancebioversityciat.org/

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