



OVERCOMING PRACTICAL IMPEDIMENTS TO BIODIVERSE TREE-PLANTING

Juniperus procera breeding seedling orchard at Yerba, Amhara Region, Ethiopia (Eyob Getah)

Introduction

Around the world, we see massive tree planting initiatives taking place. These are part of nature-based solutions that are generally acknowledged to have a significant role to play in solving some of today's most pressing global problems. These challenges include climate adaptation and mitigation; sustainable and nutritious food supply; and the restoration of forests and degraded lands coupled with biodiversity conservation. A common problem, however, is that tree planting has had only limited success in achieving the anticipated benefits. For example, restoration targets have failed because many planted trees do not survive. This is because the species and provenances used have been poorly chosen for the environment of the planting site. Compounding this, the seedlings have been insufficiently cared for, as local people have not seen the benefits of doing this, since the planted trees do not provide them with the products and services that they most need.

Trees are being planted on a massive scale around the world. However, the benefits such planting schemes are expected to provide are severely compromised by inappropriate species selection and poor survival rates. A programme in Ethiopia is demonstrating the benefits of an efficient network that can supply high quality, diverse tree planting material where and when it is needed.

Tree-based restoration requires the use of many tree species at the same time.

A major challenge of tree-based restoration work is that effective action generally requires the use of many tree species, often native, at the same time. This is hard enough to achieve when restoration is based on natural regeneration, but when planting is

necessary, it is far from straightforward to obtain a broad spectrum of genetically diverse, healthy and productive tree species' seeds or seedlings. This is largely due to their **limited current availability**. Addressing this availability bottleneck is a major challenge that current global and national restoration plans need to overcome if they are to be widely successful. Here, we outline some of the problems faced and practical solutions, based on a case study from Ethiopia.

Bottlenecks to tree seed and seedling supply

Traditional tree seed (and seedling) supply programmes focus on only a few species, with the material used often of unknown genetic quality, with only limited knowledge of its adaptation to site conditions and the local community's needs. The lack of matching of planting material to planting site leads to huge lost opportunities. Most of the seeds (and other forms of germplasm) procured by tree seed traders are collected from poorly-characterised trees in plantations, farmlands and household compounds, for which the genetic quality and origin of the seed is not known. The performance is generally suboptimal when compared to seed deliberately chosen to match a planting site.

When planting trees is necessary, a supply of genetically diverse, healthy and productive tree species is generally not easily available.



Hagenia abyssinica at Suba, Oromia (Abayneh Derero)

One factor behind the limited current availability of appropriate tree seed for planting is the **lack of knowledge** of the many opportunities for choice of species that exists, with planting programmes only considering the species they know well. This lack of demand for the trees is inter-related with the difficulty of getting hold of the planting material, which may simply be **unavailable**. Limited access to sources of tree seeds or seedlings, insufficient knowledge of propagation and broader tree management methods (and the absence of trained workers to put this knowledge into practice) and the lack of **finance** may all play a part. The suboptimal outcome is that often 'choice' is guided by what is available from local seed collections, in local nurseries or from the global seed market, rather than by any properly informed demand.

Another way to look at the problem is to think of seed supply as part of a broader value chain with different stakeholders involved at different positions along the chain. To make a diversity of planting

material **more accessible** to a range of users, the role of each of the value chain actors needs to be properly considered.

Supporting solutions to the supply problem

To improve the current supply situation, it is necessary to realise the potential of many more rural organisations, small-scale private nurseries and local communities to effectively participate in tree seed systems. In this way, responses to a relevant and more diverse demand of tree species can be met with a greater variety of supply. To do this, 'formal' and 'informal' approaches to tree seed supply need to be integrated. A key step is to support the development of informal suppliers into a well-functioning business sector that makes use of public-private partnership arrangements. These informal suppliers need business training, support in the provision of 'founder' planting material and technical guidance.

Traditional supply programmes focus on relatively few species, most of them of unknown genetic quality, often accompanied by insufficient knowledge of adaptation to site conditions and adaptability to climate change.

A crucial step in doing things better is to make the 'business case' for finance to support the tree seed sector, not only in terms of economic value but based on other values too, such as cultural and environmental ones. Analysis of returns on investment have been carried out, and these show that finance ought to be the least difficult impediment in reaching solutions. For example, conservative calculations based on African Forest Landscape Restoration Initiative (AFR100) activities suggest that an extra cost per tree seedling of less than 5% invested in improving genetic quality, under modest assumptions of uptake in the use of better planting materials, would generate more than US\$ 5 billion of additional income for tree growers, sequester 19 million more tonnes of carbon every year, and annually save 4 million more tonnes of soil from erosion. The additional investment would need, first, to cover communication of what trees to plant where for what purpose and, second, the availability of the appropriate tree seeds and seedlings for planting.

The first point requires species and seed source descriptions, including information on how different provenances perform in different environments, and management prescriptions to improve use and performance. These currently exist for relatively few tropical tree species. The second point includes the basic infrastructure for collection, storage, conservation and distribution, focusing on regions where planting should be prioritised. It also includes determining the priority demands of users and the supply capacity of producers.

Supporting tree seed supply in Ethiopia

The kind of work described above is presently being implemented in a national programme for Ethiopia. This programme is supported by the Provision of Adequate Tree Seed Portfolio in Ethiopia project (PATSPo) that is designed to support the nation's forest landscape restoration target – 15 M ha of degraded land restored by 2030 – which is the most ambitious of any country in the AFR100. The need to improve tree seed sourcing in Ethiopia was identified during earlier restoration activities, which were hampered by the lack of an efficient network for supplying tree planting material, and by the low quality and limited diversity of the tree seeds that were available.

PATSPo will support the Government of Ethiopia in promoting and strengthening existing tree-seed organizations and support the establishment of additional private and government seed dealers.

PATSPo has, with support from the Ethiopian government and the Norwegian International Forest and Climate Initiative (NICFI), been running since 2017. Its aim is to ensure access to high-quality seeds of the most important tree species used for forest landscape restoration and all other tree-planting activities in Ethiopia. PATSPo has identified stakeholders in the Ethiopian tree seed sector, promoted collaboration among them and built their capacity. Among the specific achievements to date are the establishment of a national Tree Seed Network, a climate atlas for over 120 tree

species, a web portal providing guidance on what tree to plant where in the nation (with information on associated seed sources), and the establishment of over 30 breeding seedling orchards (BSOs) of tree species prioritised by communities and government. These BSOs fulfil multiple functions: not only do they produce tree seed per se, but they support the selection and evaluation of genotype-by-environment interactions in tree performance that allow locally-adapted, genetically-diverse tree seed for growers to be identified. They also act to conserve the tree germplasm. For these purposes, each BSO is generally composed of multiple tree provenances, each represented by several families (a family = progeny from the seed originally collected from individual 'mother' trees). The description and registration of more than 200 tree seed sources has also taken place under PATSPo, mostly of indigenous trees, as well as the training of more than 1,300 stakeholders in tree seed collection and procurement methods. Online decision-support tool platforms for tree planting have also been built with PATSPo funding, including the Global Tree Knowledge Platform (Kindt et al., 2021) and the Resources for Tree Planting Platform (Schmidt et al., 2021). These platforms are of broad utility for tropical tree planting.

Although it is too early to fully evaluate how effective PATSPo will be in improving the quality of the trees planted in Ethiopia, it has



Faidherbia albida BSO, Mojo, Ormia, Region (Eyob Getahun)

worked closely with the Ethiopian government to develop policies to support the involvement of the private and informal sectors in tree seed supply. The proposed continuation of the programme 2022 to 2025 emphasises the priority it is assigned by the Government of Ethiopia.

Future prospects

Establishing tree seed supply systems to support biodiverse, including genetically diverse, tree-planting is not straightforward and is still in its infancy for most tropical trees. Devising a well-functioning system relies on users being able to express effective demand, based on access to knowledge;



Grevillea robusta BSO at Suba (Eyob Getahun)

effective production and distribution systems, reaching users with a wide variety of planting material; supportive rules and regulations for local commercial seed dealers and nursery entrepreneurs; and public investments for sustainably conserving and developing tree genetic resources. These requirements extend beyond the basic remit of most planting and restoration projects. However, PATSPO provides a good example of what can be done with modest investments. Practical planning means considering issues of tree quality at the earliest possible stage of tree planting projects' design, while at the same time not allowing the perfect to be the enemy of the good – that is, any improvement of quality is a desirable characteristic, even if this is an incremental process.

Further reading and sources of information

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Nursery for breeding seedling orchard establishment (Eyob Getahun)

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