Forest Research

Social Research for Community Tree Nurseries (CTN)

Interim Report – October 2021

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The Research Agency of the Forestry Commission

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Executive Summary

i. The Trees Outside Woodlands (ToW) Project is led by Defra, alongside Natural England and the Tree Council. It is funded by HMT's Shared Outcomes Fund. Research was commissioned by one of the pilot projects *Boosting Community Tree Nurseries*, to meet the following specific research objectives:

   a. Understand different Community Tree Nursery (CTN) models, and detail the range of benefits, costs, challenges, and unique selling point associated with each.

   b. Synthesise and assess the evidence to identify potential interventions for CTNs in the pilot project.

   c. Develop an evaluation framework to monitor and assess the interventions with pilot CTNs.

   d. Evaluate differences between different pilot CTNs and assess sustainability, benefits and any potential support needs associated with different CTN models.

ii. **A rapid evidence review** was undertaken that collated and assessed 54 studies and toolkits in the existing evidence base for data and information about different models of CTNs, and the specific successes and challenges associated with each.

iii. **Case study** research was undertaken with 16 CTNs across the UK, selected purposively according to criteria including location, site type (public or private), size (determined by numbers of trees produced), governance, and development stage.

iv. The evidence review suggested that:

- **Size matters.** The size of the community group involved (i.e. the numbers of people supporting the nursery) and business size (by number of trees produced) matters when considering sustainability and success.
- **Markets for trees are uncertain and unstable**. Markets for trees are poorly developed or unstable; combined with low selling prices and high labour inputs, this makes it challenging to achieve a steady income. Grants and incentives were shown to be critical to the viability and sustainability of many CTNs.
- **Market development can be disrupted by other programmes**. There were examples in the evidence which showed that CTNs have built markets for their trees, but this may take between 5 to 10 years. Free trees from other government or NGO projects can disrupt CTN development, even where these free tree schemes only last a short period of time.

v. The case study research found:

- It is possible to characterise CTNs both by size (production volumes) and type according to organisation, governance and objectives. These two broad forms of characterisation reveal patterns of difference and similarity between them, and provide some indication of successes and challenges associated with different CTNs.
- The four different kinds of CTNs identified from the case studies were:
    - **Organisation and project-based CTNs**. These are nurseries managed by a Local Authority, charity or partnership based on a particular site. Paid staff manage the nursery and volunteers. A range of products are produced and production volumes range from 50,000-150,000.
    - **Enterprises.** Set up as commercial or social enterprises to achieve tree production and other benefits through business methods. Paid staff manage the nursery and volunteers. A range of products are produced and production volumes range from 50,000-1,000,000.
    - **Community-based CTNs**. These are CTNs managed and run by established community groups as a community-based initiative. They may or may not have links with Local Authorities or other organisations. They are wholly managed by volunteers. Production ranges from 100-1,500.
    - **Networks**. These are CTNs that are not located on a single nursery site but instead rely on a collective of tree growers using different locations and growing techniques. The growers may or may not have links with Local Authorities or other organisations.
- Not all CTNs have either the capacity, or the desire to upscale. Upscaling may represent significant business investment and risk, or may simply change the nature of the initiative to one that is not desired by those who manage the CTN.
- The evidence suggests a generally poor level of understanding about biosecurity issues and what that means for a particular CTN and its production practices. There is also an obvious need for different types of knowledge among staff and volunteers depending on their role, skill level and individual professional competencies in this area.
- Drawing conclusions about the sustainability of different CTNs is difficult. Major challenges to sustainability appear to be:
    - an uncertain income stream,
    - maintaining staff and volunteer engagement and skills,
    - over-reliance on a few community volunteers with no succession planning.
- Looking across the evidence at expressed and identified needs, the following areas of intervention would likely have a positive impact on CTNs in terms of upscaling production, ensuring better quality and biosecure production and supply:

- Covering the costs of nursery establishment to offset lack of income and cost management over the first two years,
- Covering the costs of nursery infrastructure and land,
- Providing financial and other support to maintaining staff and volunteer numbers and contributions,
- Providing training – nursery skills, biosecurity, leadership and nursery management,
- Connecting CTNs and members to a wider community of practice.

vi. A framework for evaluation of the CTNs involved in the *Boosting Community Tree Nursery* pilot project is presented and suggests an assessment methodology. The CTNs involved will be those based in the local authorities engaged in the ToW Project (Norfolk, Cornwall, Shropshire and Kent). However, the need for a sector-wide survey of CTNs is suggested to better assess the likelihood and potential scale of increased production from CTNs, as well as answer other questions arising from this research.

1 Introduction

1.1 Background

The Trees Outside Woodlands (ToW) Project is led by Defra, alongside Natural England and the Tree Council. It is funded by HMT's Shared Outcomes Fund. The vision of the ToW project is to develop new ways of expanding biosecure tree cover outside of woodlands at reduced costs to meet the UK ambition for increased tree cover. The scope of the project includes the development of five pilots, one of which is "*Boosting Community Tree Nurseries*". The ToW project defines Community Tree Nurseries (CTNs) as tree nurseries where volunteers contribute to an element or the full process of tree seedling production. CTNs have the potential to play an important role in providing biosecure, locally sourced and diverse planting stock that can increase the resilience of the treescape. Therefore, the vision of the pilot is to support and grow a network of thriving CTNs able to contribute to the supply of diverse, biosecure and high-quality stock for tree planting in England.

The key outcomes of the pilot will be:

i. An investigation into CTNs to identify ways to enhance their contribution to the production of planting stock for Trees Outside Woodlands.

ii. A knowledge sharing toolkit created to help in setting up and running a new community nursery, with options for different scales and models, and including case studies.

iii. A demonstration hub established to provide inspiration and training/ masterclass sessions, act as a focal point for helping new nurseries to set up and to support existing nurseries.

iv. A pilot CTN plant healthy certification group established.

1.2 Aims and objectives

The social research undertaken as part of the *Boosting Community Tree Nurseries* pilot was undertaken to meet outcome i., and to contribute to outcome ii. This was achieved by meeting the following specific research objectives:

1. Understand different CTN models, and detail the range of benefits, costs, challenges, and unique selling point associated with each
2. Synthesise and assess the evidence to identify potential interventions for ToW pilot CTNs
3. Develop an evaluation framework including key Criteria and Indicators (C&I) to monitor and assess the interventions with pilot CTNs

4. Evaluate differences between different pilot CTNs and assess sustainability, benefits and any potential support needs associated with different CTN models.

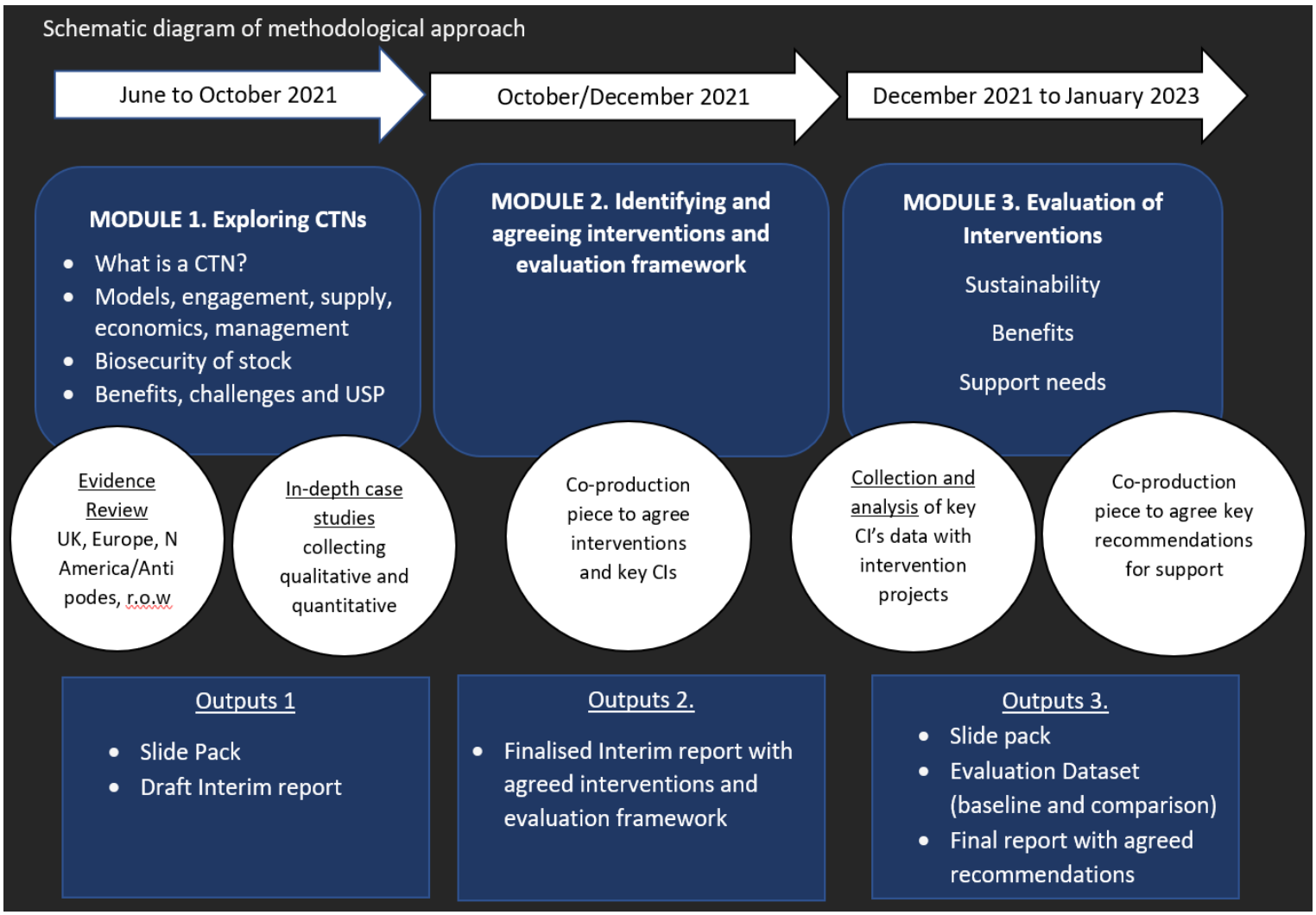
1.3 Methodological approach

A schematic overview of the project approach is illustrated in

Figure 1 below. Three phases of research, described as "modules", were designed to build the evidence and knowledge required to meet the research objectives. Module 1 was designed to provide information that characterises CTNs; Module 2 built on this and developed an appropriate assessment framework that could be used to evaluate the successes and potential outcomes of CTNs; and Module 3 is concerned with collecting data to assess the effects of the financial and other support provided to the CTNs involved in the Boosting Community Tree Nurseries pilot.

At this Interim Reporting stage, Modules 1 and 2 are completed, and Module 3 is underway.

Figure 1 A schematic description of the project approach and plan



2 Understanding CTNs and opportunities for intervention

This part of the report describes the work undertaken in Module 1, including the method and results.

2.1 Method

The research in Module 1 focused on understanding more about CTNs and where interventions might support them to achieve the pilot project objectives. This involved investigating a range of different types of CTNs, to evidence more about the potential benefits and challenges experienced by CTNs operating in different ways, and to find out more about tree production methods and the biosecurity implications. This was achieved by conducting:

i. **A rapid evidence review** that collated and assessed the existing evidence base for data and information about different models of CTNs, and the specific successes and challenges associated with each.

ii. In-depth investigation of 16 **case study CTNs** of varying types and sizes in England, Scotland and Wales.

2.1.1 Rapid Evidence Review

A rapid evidence review was conducted using key word searches in databases including Scopus, Science Direct and Google Scholar. The search was not limited by date range or country coverage.

The key word search terms were as follows:

- "tree nurser*" [AND volunteer OR community OR CSR]
- "tree nurser*" [AND small scale OR micro]
- "social enterprise" [AND trees OR growing OR horticulture OR arboriculture OR landscaping OR nurser*]
- "community-based enterprise" [AND trees OR arboriculture OR horticulture]

A total of 35 documents were collated as the evidence set, of which 27 were assessed to have insights of relevance to the UK context. The majority of the studies examined community and small-scale nursery enterprises in Africa and Asia. Three useful handbooks or guides were identified, which again, although focused on developing country contexts were picked up as example "toolkits" with sections and thematic approaches that are of relevance to the UK context. All evidence was used to identify different types and models of CTNs and key lessons learned.

An annotated bibliography of the academic journal papers and documents is included as Appendix 1.

2.1.2 CTN case studies

A list of 49 CTNs across England, Scotland and Wales was produced in collaboration with the *Boosting Community Tree Nurseries* pilot team. We believe this list captured a large proportion of existing CTNs. This sampling frame included information about key variables of interest including, location, site type (public or private), size (determined by numbers of trees produced), governance, and development stage. A final target sample of 16 case studies was purposively selected through discussion with the project team who reached agreement on those case studies best able to provide insight into the range of different types and ages of CTN. A summary of the sample CTNs is included in Table 1.

Table 1.Summary description of the 16 case study CTNs

No.	Country	Years established	Overview
1	Wales	2	CTN established by NGO to produce rarer tree species to supply local landowners and farmers.
12	Wales	13	CTN with strong educational focus in addition to selling trees locally.
3	Scotland	26	Large, remote CTN managed by a conservation charity. Trees used on the charity's land and also sold to nearby projects.
11	Scotland	10	Established as part of landscape partnership, large CTN selling local and rare trees in remote location.
2	England	14	Large charity-run CTN growing trees on two sites. Sells trees to local landowners and projects.
4	England	25	Small, community-based CTN selling trees locally.
5	England	22	CTN based on council land and providing trees for local parks. Also involved in after-care of trees.
6	England	4	Network of volunteer growers organised by an NGO, to collect seed and grow trees in their gardens.
7	England	1	Project establishing CTNs in a network of institutions, ambition to produce large number of trees while training institutional residents.
8	England	23	CTN which operated for over 20 years, trees were distributed among tree warden network.
9	England	24	CTN which focused on seed collection, most of which was grown-on by a commercial nursery.
10	England	2	Early stage CTN run by key individual with a few other volunteers.
13	England	32	Established alongside Community Forest, to support planting there.
14	England	2	Network of tree wardens growing trees in their gardens. Trees are planted throughout the county.
15	England	1	CTN based within a designated landscape, providing trees for park and wider water catchment.
16	England	5	Large council-run nursery with a volunteer element, producing plants and trees for council, agencies and private customers.

An interview guide (see Appendix 2) was developed in collaboration with the *Boosting Community Tree Nurseries* pilot team. This was used to structure discussions with representatives from the case study CTNs. The discussions were conducted on-line through Microsoft Teams, between August and October 2021. Each encounter lasted between 25 and 65 minutes. Encounters were recorded but not transcribed. Researchers summarised the key information emerging from the discussions using a recording sheet (see Appendix 3). In addition, informants provided some basic data descriptive data about their CTN using a short Survey Monkey form, which they completed before or after their interview.

Additional material including notes provided by the project lead, information sourced from case study websites, and documentation provided by CTNs themselves were used with the researcher interview notes to build up a picture of the case study CTNs.

Interview data and supplementary information were discussed by the researchers and the whole pilot project team respectively. These discussions helped to define clear areas of interest to the project. Researchers extracted qualitative data from the interview record sheets relevant to these areas of interest and discussed their significance. The findings of these discussions are found in this report.

Quantitative data from Survey Monkey was cleaned and used to generate simple summary charts. Because the questions were optional, respondents may have skipped some. This means there is some variation in sample size displayed as indicated.

2.2 Synthesis of results

2.2.1 Characterising CTNs through the evidence review

Looking across the published evidence, there is no single definition of a community tree nursery. The review illustrates that CTNs have been defined and characterised in different ways, including by:

- function and main objectives,
- governance/ legal arrangements,
- outputs (i.e. numbers of trees and other products produced), and
- business model.

For example, work across Asia characterised CTNs by lead organisation and purpose, and identified a major division in the effectiveness of working, degree of community engagement and numbers of trees supplied between time-bound project focused CTNs, and those run on semi-commercial models but supported by government or NGOs (Roshetko et al., 2010). Different research looking at CTNs in Africa and North America showed that CTNs are very often established to fulfil specific functions, most frequently to serve tree planting programmes and projects for public benefits where the level of support from

conservation agencies and charities is high, and where commercial viability of the CTNs is not the primary concern (Botha et al., 2005, Botha et al., 2007, Eisenman et al., 2021).

Regardless of the type of CTN investigated the evidence did reveal some commonly observed features across countries and examples:

- **Size matters.** The size of the community group involved (i.e. the numbers of people supporting the nursery) and business size (by number of trees produced) matters when considering sustainability and success. Although the evidence characterises CTNs in different ways, there seems to be agreement that medium/middle sized CTNs (c. 10,000 trees), seem to perform better than smaller and larger CTNs. Smaller CTNs may face challenges around the economics of production which may lead to their demise. Larger concerns can be challenged by the scale of production including the need for skilled labour, efficient processes and mechanisation of some parts of the production process, with poorer quality trees a potential outcome.
- **Markets for trees are uncertain and unstable**. Markets for tree seedlings were described as poorly developed or unstable due to significant fluctuations in demand year on year, in all the countries and examples included in the evidence. Fluctuating and uncertain market conditions combined with low selling prices and high labour inputs means that achieving a steady annual net profit or achieving income needed to manage cost offsetting is not at all common among CTNs. Government or organisational incentives or support, including grants, was shown to remain important for CTN viability and sustainability.
- **Market development can be disrupted by other programmes**. There were examples in the evidence which showed that CTNs have built markets for their trees, but this could take between 5 to 10 years. Free trees from other government or NGO projects can disrupt CTN development by displacing demand, even where these free tree schemes only last a short period of time.
- **There are common financial challenges**. The key challenges and barriers that were repeated through the studies included: poor access/availability or high cost of land and space for the CTN; and the capital and recurring costs of nursery infrastructure (e.g. irrigation) and consumables such as good quality growing medium; poor tree quality due to lack of finance to support good growing practice, and lack of expertise or skills training, which damaged CTN reputations and lead to low demand.

2.2.2 Characterising CTNs through the case studies

Looking across the data generated by the case studies, there were some discernible patterns structuring the differences between CTNs. Even though the case studies represent a small amount of evidence from perhaps around a third or less of the total pool of CTNs, these patterns do indicate differences which will have an impact on the likely effectiveness

of different intervention strategies, biosecurity practice, and the potential to produce significant volumes of quality trees. The main areas of difference were around:

- organisation and governance model,
- the objectives of the CTN,
- the type of community engagement, and
- the size and type of production.

2.2.2.1 CTN governance models

Looking across these areas of difference a broad characterisation of CTNs suggests there are four governance models discernible amongst the case studies. These are:

- **Organisation and project-based CTNs**. These are nurseries managed by a Local Authority, a charity (e.g. Wildlife Trust) or partnership project (e.g. Community Forest). They were associated with a particular site or a particular project. Paid staff manage the nursery and volunteers. Rangers, project officers, and other role holders were involved in decision making and managing the running of the CTN.
- **Enterprises.** These are CTNs set up as commercial or social enterprises to achieve tree production and other benefits through business methods. Trees are sold at cost or for profit. Paid staff manage the nursery and volunteers. Whether constituted as commercial or social enterprises, these CTNs are concerned with financial sustainability. Those in our sample were responsible for producing the largest number of trees.
- **Community-based CTNs**. These are CTNs managed and run by established community groups who run a tree nursery as a community-based initiative. They may or may not have links with Local Authorities or other organisations. They are wholly managed by volunteers.
- **Networks**. These are CTNs that are not located on a single nursery site but instead rely on a collective of tree growers using different locations and growing techniques. The growers may or may not have links with Local Authorities or other organisations. They may work collectively to gather seed and distribute seedlings, or they may undertake these actions on behalf a project or organisation. If growing trees for an organisation or project, seeds or plants may be provided to them to grow on.

A summary of the characteristics associated with the different kinds of CTN models is shown in Table 2 below.

Table 2. Summary characteristics of CTNs by different governance models

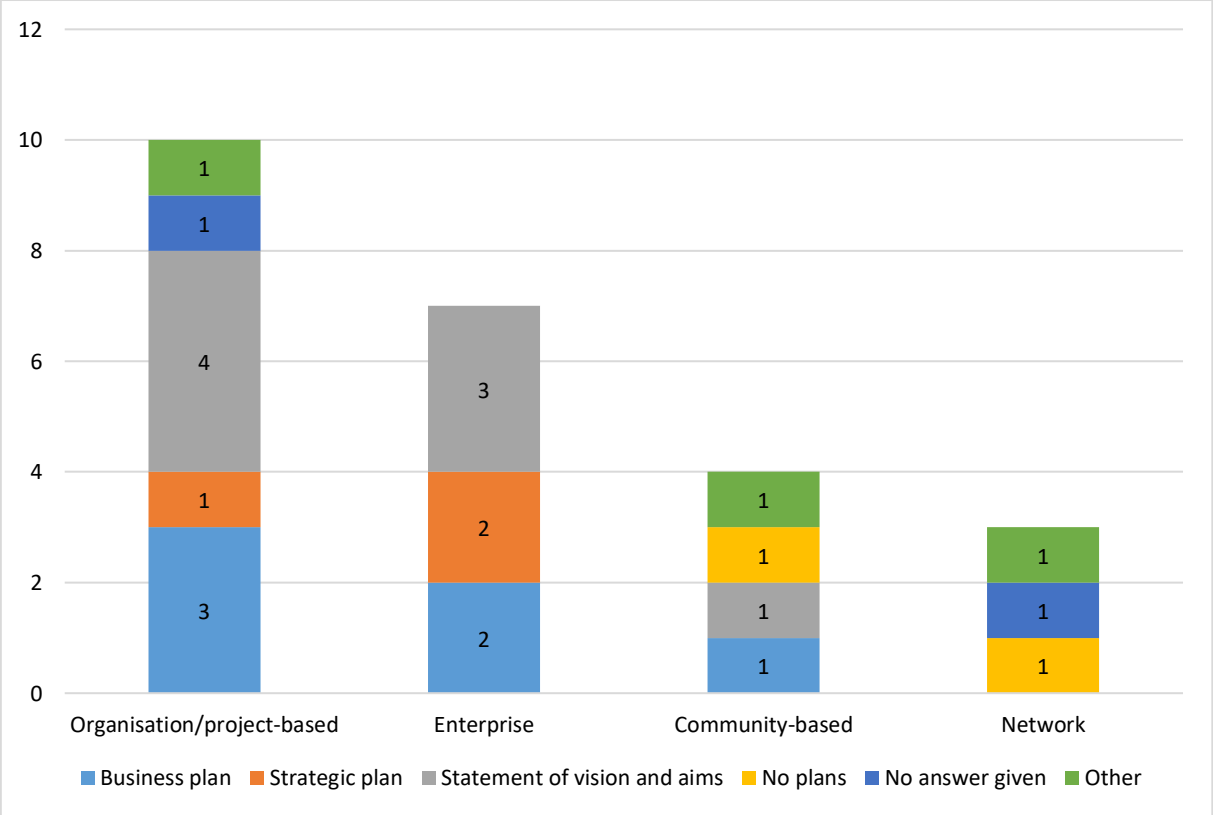
Type of CTN	No in our case studies	Size (production volume p.a.)	Supply	Use of volunteers	Land
Organisation and project-based	7/16	600-130,000	• Sold and donated • 7 supplying direct to organisation or project • 7 offering for sale	2-20 regular volunteers managed by staff	Owned by the organisation/project (6 out of 7)
Enterprise	3/16	3,000-1,000,000	• Sold • 0 supplying direct to organisation or project • 3 offering for sale	4-30 regular volunteers managed by staff	Rented/leased (3 out of 3)
Community-based	3/16	100-1,500	• Sold and donated • 2 supplying direct to organisation or project • 2 offering for sale	4-30 regular volunteers managing themselves	Rented/leased but at peppercorn rates or free (3 out of 3)
Network	3/16	150-3,000	• Donated • 3 supplying direct to organisation or project • 0 offering for sale	4-20 volunteer growers managing themselves or managed by an organisation	On volunteers' own property, parish allotment or land belonging to local groups, e.g. Scouts (3 out of 3)

2.2.2.2 CTN objectives and strategic planning

The CTNs in the sample all had very similar objectives around producing good quality trees for public benefits, and leveraging some social benefits through volunteer and community engagement. It was the balance of those objectives and any objectives around financial benefits which differed between them.

How the CTNs translated these objectives into strategic planning tools guiding their development, the size and type of production, the degree to which they focused on grant capture, and the type of community engagement integrated with tree production differed. Figure 2 shows that a third of the sample had translated these into either a business plan or a strategic plan. *Organisation/project-based* CTNs and the *Enterprise* CTNs were more likely to have a collection of more than one type of plan, including a business or strategic plan to guide their operations. A statement of vision and aims was the most common strategy document across CTNs. *Network* CTNs were least likely to have any kind of strategic guidance/documentation. It's important to note that just one of the CTNs, a *Community-based* CTN, mentioned having a specific biosecurity plan in place, this was in the form of a biosecurity risk assessment.

Figure 2. Strategic planning documents used by case study CTNs (n=12)*



NB. CTNs could have more than one document type

2.2.2.3 Type of community engagement – activities and benefit flow

Depending on the type of CTN considered community engagement is normally arranged in the form of volunteering sessions, which may be led and managed by members of staff, or by voluntary volunteer organisers. The *Community-based* initiatives were the only examples where decision-making about the running and development of the CTN sat in the hands of community members alone.

The way in which volunteers are engaged is very varied, and included: volunteers joining established and regular working parties and volunteering sessions; taking part as paying guests on "working holidays" or as participants in specific training courses; joining in with educational or special interest events using the CTN as a third parties, e.g. working with prisoners, health and wellbeing groups, or with employability and skills focused groups.

The different kinds of activities that volunteers are involved with included:

- Seed collection, which was the most common activity as it was carried out with volunteers in each of the case study CTNs. This also reflects that the most common tree production method across the case studies was through collected seed.
- Collecting wildings, i.e. self-sown trees for growing on or potting up for transplanting
- Growing tree seedlings, which included a variety of contributions depending on the type of CTN, but with all CTNs stating that volunteers take part in all parts of the tree growing and production process
- Planting the trees produced onto a specific site is most commonly associated with *Organisation/project-based* CTNs, although often these CTNs do not exclusively own their own sites
- Maintaining the trees planted at specific sites
- Taking part in courses and learning events
- Contributing to the management and maintenance of the nursery itself

Although none of the CTNs involved in the research had assessed or evaluated (i.e. measured), the additional benefits they might be leveraging beyond tree production, a broad range of perceived social benefits were noted regardless of the type or size of CTN being considered. These included:

- Social capital and community cohesion brought about by social interaction, particularly between different types of people within a community, and amongst those meeting regularly
- Health and wellbeing benefits through nature connection, physical exercise and through social contact and socialising
- Learning and skills development
- Employability

- Volunteers and others developing a sense of being useful and contributing to something important
- Environmental improvement in community or particular locale
- Changing community attitudes and perceptions towards trees and nature.

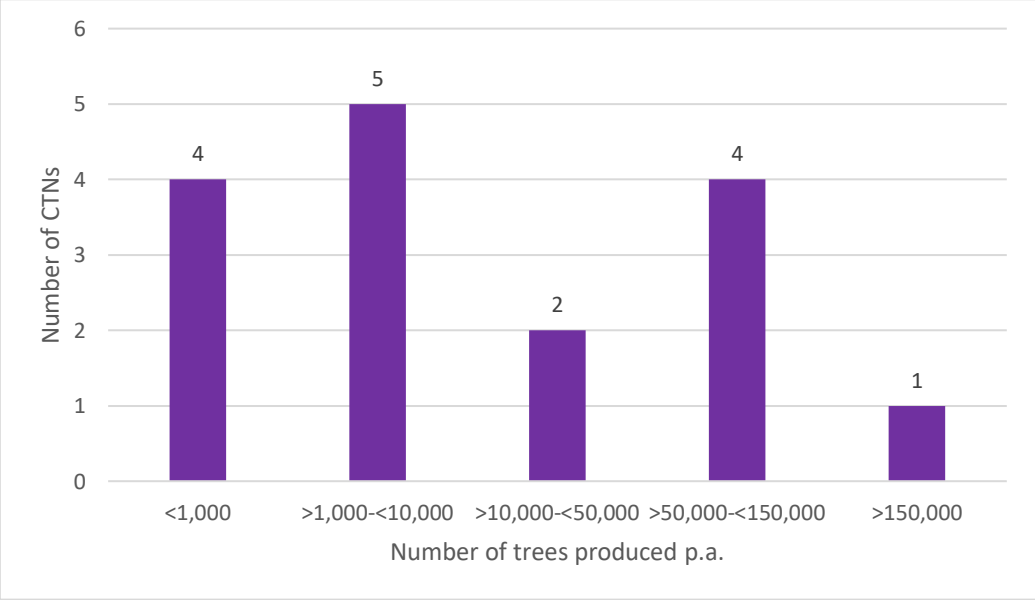
The following statements provide an illustration of the benefits those involved saw from community engagement:

> *People have expressed enormous wellbeing benefits...* (*Enterprise* type CTN)
>
> *We're building communities around the parks…it's like having a little tree warden scheme for each park* (*Community-based* CTN)
>
> *[Volunteers] get a sense of fulfilment from doing something useful – that's what they keep telling us* (*Organisation/project-based* CTN)
>
> *[Volunteering's] great in terms of community involvement but also a resource. There's a reality that councils don't have the staff to plant this many trees, so if we don't do it with volunteers, it's just not going to happen* (*Enterprise type* CTN)

2.2.2.4 Size and type of production

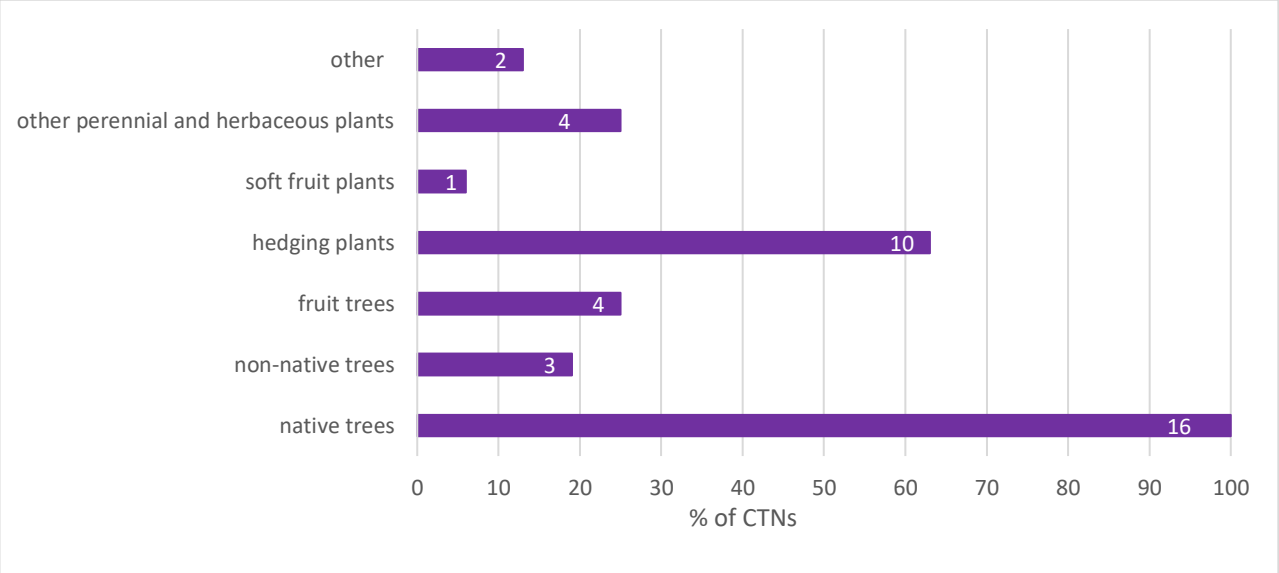
Looking first at production volume, Figure 3 illustrates that there is a significant range across the case studies with smaller CTNs typically producing less than 1,000 trees a year, and the largest producing up to 150,000. The smaller initiatives in our sample were *Community-based* CTNs, larger initiatives included examples of *Organisation/project-based*, *Enterprise* and *Network* CTNs.

Figure 3. Size of case study CTNs by numbers of trees produced (n=16)



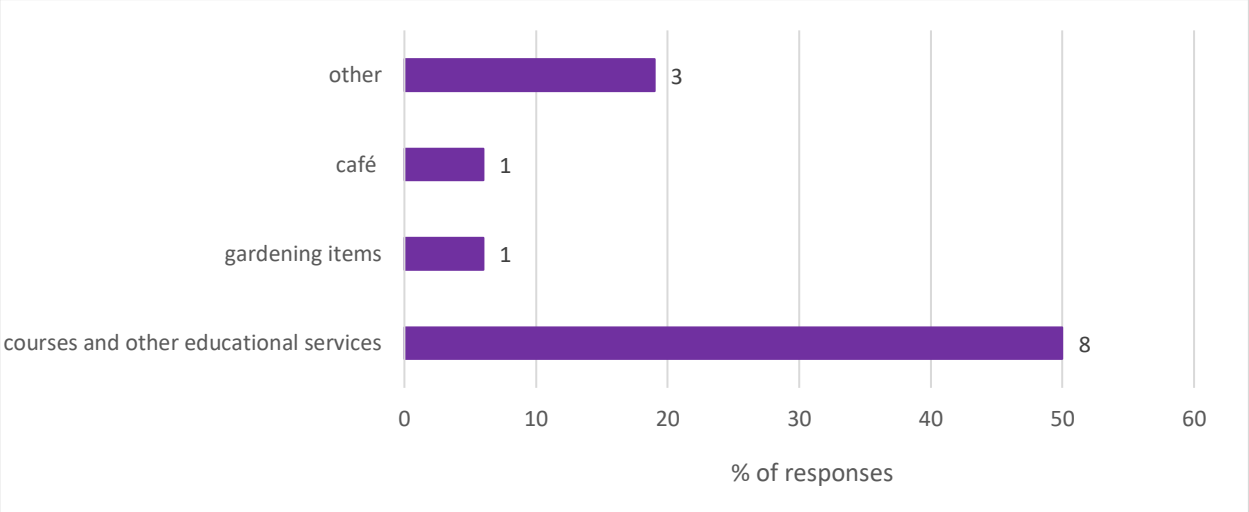
In terms of what is being produced Figure 4 shows that all CTNs are producing native trees and most are producing hedging plants. Around a third of case study CTNs are growing non-native trees and fruit trees, and a third products other than trees. Seven CTNs are selling their trees, nine provide trees free of charge. These CTNs are supplying a range of individuals and organisations, such as an associated project partner, Local Authorities, government agencies and local landowners. About half of the CTNs offer some kind of training or opportunities for educational experiences, one has a café, and one sells gardening items (see Figure 5).

Figure 4. Type of trees and other horticultural products produced by case study CTNs (n=16)*



** Other = annual bedding plants and montane plants*

Figure 5. Other products and services provided by case study CTNs (n=10)*



**Other = none, advice to new tree nurseries, possibly courses in future*

Looking at the production trees, all the case study CTNs are growing from seed (see Figure 6) with a minority collecting self-sown trees for potting-on. A quarter of those sampled bought in plants from other nurseries to grow on. All bar one CTN are sourcing and propagating local provenances, with the majority focusing exclusively on local provenance, and the rest doing so most of the time (Figure 7).

Figure 6. Tree production methods used by case study CTNs (n=16)

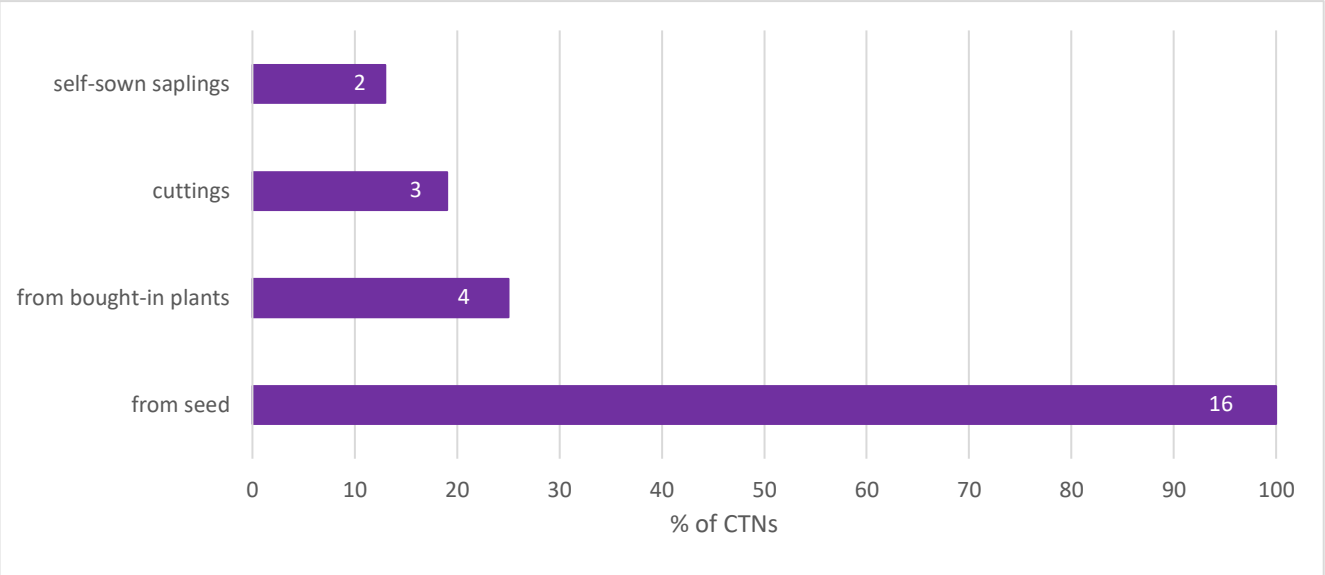
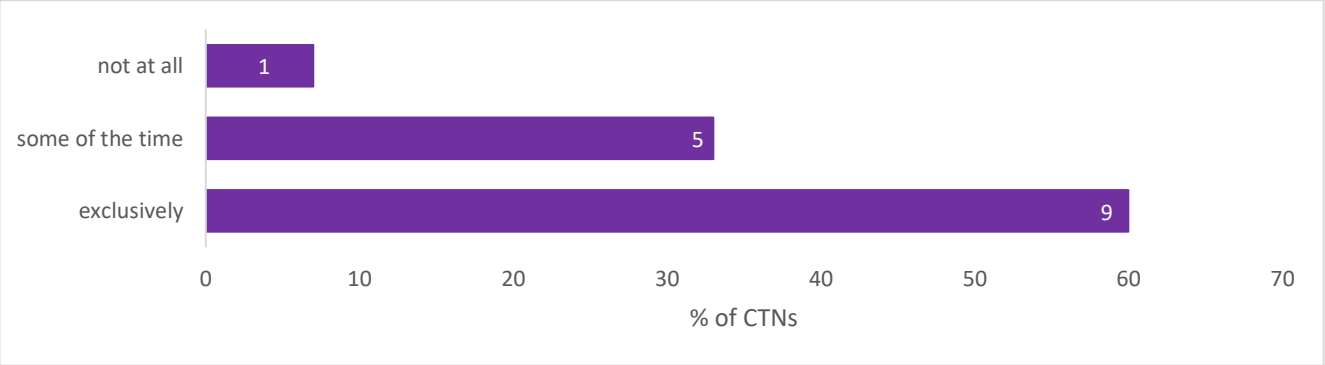


Figure 7. Use of local provenances by case study CTNs (n=15)



2.2.3 Success and sustainability

When asking CTNs about how they achieved their objectives and what contributed to sustainability, the following common factors were mentioned:

- Subsidising start-up
- Articulating a clear vision and aims for the CTN
- Leadership and management

- Being part of a network of practice
- Understanding demand for trees: markets and recipients

Each of these issues is described more fully below.

Subsidising start-up. All the case study CTNs, regardless of type and size, had relied on some kind of financial support as they established, and which they considered to have been essential to their establishment. This was either in the form of an initial grant or financial exemption, as free use or peppercorn rent for land. The range of grants and financial support provided ranged between £10,000 to £15,000. This financial support had contributed to the high capital costs of basic infrastructure and systems, including the costs of managers and volunteers setting these up, and covering the other costs of the first production cycle before any potential income stream from trees.

As one person put it:

> *We do feel…that…the money it would cost for a smaller nursery or someone starting from afresh, to actually get set up and deal with growing trees on any sort of scale…unless there's significant government help it would be very, very difficult because…a lot of businesses need a return on investment and cash flow straight away.* (*Enterprise* CTN)

A clear vision and aims for the CTN. Establishing the primary objectives of the CTN and what it was trying to achieve were mentioned as being key to providing clear direction for the initiative, as well as being able to communicate to volunteers what their efforts were contributing to. This was important to engage them initially, as well as to maintain their interest. Also important is a clear articulation of the expected outcomes. This includes such issues as balancing aims to produce trees and aims to leverage other social or environmental benefits. For example, one case study CTN produces one hundred half-standards a year but places a great emphasis on the care of these trees in the nursery and beyond. Their objectives extend to engaging with and encouraging members of the local community to maintain the trees they produce where they are planted out.

> *I feel this is the most fundamental issue: having a potential project to work towards is essential.* (*Community-based* CTN)

> *It very much wasn't trying to pretend to be a proper nursery; it was much more around the engagement than the productivity.* (*Organisation-based* CTN)

A management plan was mentioned by some CTNs as being important for ensuring continuity in approach to the management of the nursery, as well as providing tangible goals for everybody to work towards.

Leadership and management. It is important to have a person or group of people who can make decisions and lead the organisation and governance of the CTN to achieve its vision and aims. Leadership in CTNs with a paid member of staff appeared strong and clearly defined but comes at a financial cost which cannot be borne by many CTNs.

Furthermore, CTNs supported by a wider organisation or charity often have support around administration and management, enabling the nursery staff member to focus energy on overseeing production and engaging with volunteers. Without this kind of support, it is difficult for a CTN to develop further, as CTN members are occupied with nursery operations. Coordination can be particularly challenging for networks, which by their nature have activity spread across multiple sites. Three *Community-based* CTNs described the difficulty of delegating certain tasks, explaining that it didn't seem right to ask volunteers to do something if they had not expressed an interest in it.

> *We have an employee; they're so much more valuable than a volunteer because they're here week in week out, day in day out, and they really understand working in the place…but there is a cost to that of course.* (*Organisation/project-based* CTN)

Being part of a network of practice. Networking and peer-to-peer learning were consistently mentioned as adding high value to CTN members' confidence and understanding of the sector. Interviewees explained how networking enabled them to learn about a range of things, such as information about grants, technical issues, sector-wide trends, and local demand for stock. A couple of CTNs discussed established networks – either CTN-focussed or with a wider environmental scope – which were seen as useful for connecting with like-minded and supportive contacts; whereas others shared stories of visiting successful CTNs to witness good practice for themselves. It was evident that the social contact and sense of encouragement from these encounters had a profound positive impact on interview participants.

Understanding demand for trees: Markets and recipients. It is important for CTNs to understand the local market and build relationships with individual customers and larger scale tree-planting projects. Demand forecasting is challenging for all CTNs – even *Organisation/project-based* CTNs which often supply other landowners and projects in addition to their own. Demand for species, type of product and quantity are not easy to predict. However, well-established relationships with local stakeholders and customers can help protect against market uncertainty. Part of understanding markets includes competition from other businesses, projects or schemes can impact the viability of CTNs – for example, one CTN cited the Woodland Trust's MOREwoods[1] scheme as partly accountable for its decision to cease operation. One CTN (*Enterprise*) explained how it had an agreement with the Woodland Trust that the MOREwoods scheme would not operate in the area it serves.

[1] https://www.woodlandtrust.org.uk/plant-trees/large-scale-planting/morewoods/ this scheme provides 500 plus saplings, advice and funding to establish new woodlands on at least half a hectare

2.2.4 Key barriers and challenges

The most important barriers and challenges to CTNs achieving their aims and objectives, which have particular relevance to the Boosting Community Tree Nurseries pilot project included:

- Managing biosecurity
- Accessing land and critical infrastructure
- Maintaining income
- Maintaining a volunteer base
- Managing growth and succession
- Planning production for future resilience.

Each of these issues is discussed in more detail below.

Managing biosecurity. This was seen across all the case studies to be a challenge, but CTN response to this challenge was variable. Biosecurity was more likely to be considered carefully if the CTN was managed by an individual with professional horticulture or forestry experience. Such CTNs described making provision for quarantining stock, washing footwear and equipment, and record-keeping. A well-established large, CTN is in the early stages of collaborating with an app developer to create an app which could support CTNs with their biosecurity. Out of sixteen CTNs, three had considered Plant Healthy certification, but only one is actively working towards it. Certification, such as Plant Healthy or official documentation such as plant passports, were regarded as too costly and complicated, or not appropriate to the enterprise. In a couple of instances, the administration associated with plant passports had contributed to a decision to not sell produce. A recently established *Community-based* CTN has created its own biosecurity risk assessment after receiving biosecurity guidance from Norfolk County Council. **A common misconception** and important narrative were that **'local varieties' and provenances, locally collected seed and 'small-scale' operations pose no, or very minimal, biosecurity risk.** One CTN explained how volunteers sometimes donate plants from their holidays, indicating a dangerous lack of biosecurity understanding. Amongst the interview respondents, there were significantly few mentions of the need for biosecurity support and guidance, which seemed a result of CTNs not knowing what they don't know rather than already following best practice. As one person remarked:

> *There wasn't the strongest adherence to biosecurity protocols by our lead individual…and the volunteers...many of them were certainly more lax than that…it's a challenging area.* (*Organisation/project-based* CTN)

Accessing land and infrastructure. Accessing land is an issue particular to *Enterprise*s and *Community-based* CTNs, whereas infrastructure is more of an issue for *Network*s and *Community-based* CTNs. Almost all the CTNs interviewed either pay nothing to rent their

site or pay a negligible/peppercorn rent. This type of arrangement seems critical in allowing CTNs to operate without debilitating rent costs. Most of these arrangements seemed secure, but there were a couple of instances where tenancy had been threatened. Tenancy seemed most secure where the landlord – for example, the local council – is invested in the CTN's objectives and outputs. Access to land was often cited as a barrier for nursery development and potential for increasing production. Sourcing reliable irrigation was critical for CTNs with dedicated sites (less so for those growing in their own gardens). The reliance of good biosecurity upon sufficient space and irrigation should be noted.

Maintaining income and income flow. The majority of the CTNs in the sample are supported by grants which make up the larger portion of income share. The short-term nature of grants – often on a one-year cycle – creates financial instability. Continually finding and applying for grant funding opportunities creates a significant amount of stress and administration for CTN members, and does little to encourage growth and upscaling. It also creates uncertainties around staffing where employees' wages are dependent on grant funding, which can lead to high staff turnover, loss of knowledge and skills, and have an overall impact on levels of production.

Maintaining a volunteer base. All CTNs emphasised the integral role volunteers play in nursery operations. Most CTNs have been successful in recruiting volunteers, but some challenges persist, such as remote locations and high age demographics. Covid-19 restrictions were cited as being a significant setback to some nursery operations. In particular, one CTN – which operates a residential volunteer week model, i.e. where volunteers stay at the project site for a week to volunteer - was forced to employ more staff to mitigate the lack of volunteer labour. Different engagement strategies are employed according to context, but there are opportunities for CTNs to learn how this can be done effectively.

Succession planning. Planning for the future was mentioned as important for a number of reasons, including: ensuring a stable governance structure, ensuring staff and volunteer succession and avoiding over-reliance on a small number of key individuals. *Organisation/project-based* and *Enterprise* CTNs in the sample where a wider pool of staff and volunteers supported the initiative and volunteer management appeared more confident about succession and sustainability. For example, one of the *Enterprise* CTNs explained how they had recently moved the organisation's account names, passwords etc away from the personal account of the nursery manager to an organisation-wide set of accounts. The same CTN also has 'key man' insurance which would provide financial support for six months should the nursery manager/director be made absent by unforeseen circumstances. The *Community-based* CTNs with little formal support seemed to be overly reliant on just one or two key individuals, which could have negative impacts on the people involved (burn-out for example), or could act as a barrier to change and growth of that particular CTN (e.g. becoming subject to "founder syndrome"). The following quotes are illustrative:

When I think of the length of time, I have run our tree nursery voluntarily, I regret not approaching a large local organisation to try and get their sponsorship, as we could never find a grant that paid for staff. As an already established nursery, it was impossible (*Community-based* CTN)

I have tried to find a suitable successor for managing the nursery for a number of years, but being voluntarily run is not an incentive, neither has it bred someone who can deal with responsibility. There is not enough money for a paid worker from the sales of only 1500 or so trees a year, £10-£15 a week at most!
(*Community-based* CTN)

Upscaling capacity and managing growth. On the question of increasing CTN production capacity, four CTNs appeared enthusiastic for expansion, two placed an emphasis on 'sustainable' expansion, one claimed to be incapable of expansion without additional infrastructure, and five stated an aversion for expansion; often motivated by desire to focus on quality over quantity; two CTNs did not discuss expansion and the remaining two no longer operate, so expansion is not applicable. There was some uncertainty over how best to scale operations and manage growth sustainably. A couple of CTNs explained that this had been a point of disagreement among different CTN members, providing a people management challenge as well. For the larger CTNs in the sample, upscaling volumes beyond the 50,000 and 90,000 tree p.a. they currently produced would require an increased investment in order to obtain the necessary additions of land, machinery or site infrastructure. This was not something they were necessarily interested in doing partly due to the risks and efforts, and partly as it represented a different kind of business to them.

Planning production for future resilience. There was some uncertainty from two *Organisation/project-based* CTNs and the *Enterprise* CTNs with professional horticulturalists and tree nursery personnel, about whether producing trees of local provenance was the most suited to future resilience, or whether producing trees with e.g. more southerly provenances was a better option for production and sale.

2.2.5 Knowledge and information gaps

When we asked CTNs what additional knowledge and information could support the establishment, development and maintenance of CTNs the following list emerged - there was no clear differentiation in the requests by CTN type or size:

- Network establishment and support for peer-to-peer learning and exchange (n=3)
- How to find and apply for grant funding to support CTNs (n=3)
- Mentoring from and visiting example CTNs as a form of peer-to peer learning (n=2)
- Nursery business planning and management (n=2)

- Resource navigation – pointing to other existing resources e.g., seed collection guide (n=2)
- Information about tree nursery regulations and biosecurity practices appropriate to different types and sizes of CTNs (n=1)
- Nursery record-keeping, e.g. origin of plant, plant movements, origin of materials inc. soil, potting on dates (n=1)
- "How to" technical sheets for volunteers e.g., pruning, seed collection (n=1)

2.3 Conclusions

Broad conclusions around five topic areas can be drawn from these results.

1. Characterising CTNs

It is possible to characterise CTNs both by size (production volumes) and type (according to organisation, governance and objectives). These two broad forms of characterisation do reveal patterns of difference and similarity between them, and they provide some indication of successes and challenges associated with different CTNs. However, it is not possible to draw definitive conclusions about whether one type of CTN is more or less likely to be sustainable, upscale more easily, manage biosecurity more successfully, or secure greater social benefits. Since nearly all the CTNs in our research were led by some statement of vision and aims, assessing the success of any particular CTNs should be related to those declarations.

2. Upscaling production

Not all CTNs have either the capacity, or the desire to upscale. Some of the *Community-based* CTNs for example, are limited by the available energy, time and objectives of the pool of volunteers that run them. Upscaling may just not be something they want to do. For *Enterprise* CTNs upscaling may not be a desired objective either, moving from production of up to c. 100,000 trees per annum to larger volumes seems to represent a significant business investment and risk, and changes the nature of the enterprise to one where the benefits of community involvement are recognised as probably being somewhat different. CTN production is also very variable in terms of the age and type of trees being produced, so measures of volume are not necessarily the only criteria that needs to be considered. Producing larger and older trees is an objective of some CTNs so the upscaling considerations can be somewhat different. The quality of trees produced was recognised as being important, but discussion about the links between upscaling and maintaining quality were not prevalent in the data.

3. Biosecurity concerns

The evidence from the case studies suggests that there is a generally a poor level of understanding about biosecurity issues and what that means for a particular CTN either

around seed collection or tree growing through the growing process or the supply of trees from third parties for growing on. Myths and assumptions exist about biosecurity, e.g. local seed and small nurseries do not present a risk. There is also an obvious need for different types of knowledge amongst staff and volunteers depending on their role, skill level and individual professional competencies in this area. Whilst it is certainly true that schemes and programmes such as Plant Healthy that are designed for and suited to large scale commercial growers are not appropriate for many of the CTNs sampled in this research, that does not mean there is no need to raise the level of awareness and understanding of biosecurity issues and good nursery practice suited to the size and kind of CTN.

4. Sustainability

Drawing lessons and conclusions about the sustainability of different CTNs is difficult. Some of the factors that contribute towards sustainability that emerged from the research were to do with leadership, having clear and agreed aims and objectives and being guided by some kind of strategic, business or operational plan. The major challenges to sustainability appeared to be: an uncertain income stream – tied into the reliance on and cycle of finding and applying for grants as well as unpredictable and variable markets for the trees produced; maintaining staff and volunteer engagement and skills; over-reliance on a few community volunteers carrying workloads single-handedly, particularly in *Community-based* initiatives and where initiatives had no succession planning or support from organisations with paid staff and others to contribute to nursery management as well as staff and volunteer management.

5. Opportunities for intervention

Looking across the evidence at expressed and identified needs as well as statements about what factors contributed to success and sustainability, the following areas of intervention would likely have some impact in terms of upscaling production and ensuring better quality and biosecure production and supply:

- Covering the costs of nursery establishment to offset lack of income and cost management over the first two years
- Covering the costs of nursery infrastructure and land
- Providing financial and other support to maintaining staff and volunteer numbers and contributions
- Providing training – nursery skills, biosecurity, leadership and nursery management
- Connecting CTNs and members to a wider community of practice.

3 Evaluation of Interventions

The *Boosting Community Tree Nurseries* pilot has already and will continue to provide grant funding and other support to CTNs based in the local authorities involved in the ToW Project (Norfolk, Cornwall, Shropshire and Kent). The support that has been given and is planned to be given includes:

- Grant funding for capital items and infrastructure (e.g. fencing, irrigation equipment, polytunnel).
- Grant funding for staff (e.g. contributions to salary costs).
- Training including biosecurity.
- Training and community of practice networking encounters through Facebook group[2].

The focus of support is largely with newly established and establishing CTNs, and is aimed at providing support that will lead to short and medium term impacts around increased production volume and plant quality, as well as improved biosecurity practice and the production of social benefits through community engagement.

To date it is anticipated that around 20 CTNs will receive some form of direct support through the period of the pilot project.

3.1 Evaluation Framework and Assessment methodology

Designing an evaluation framework to understand the outcomes and impacts of the interventions is relatively challenging. There are a small number of CTNs in the pilot project, the mix of interventions the CTNs may have received is very variable, some of the expected and desired outcomes and impacts are unlikely to occur within the evaluation period, and some of the indicators are difficult to measure or relate to a baseline because the CTNs are newly establishing.

The recommendation is to approach the evaluation of *Boosting Community Tree Nurseries* pilot through the following approach.

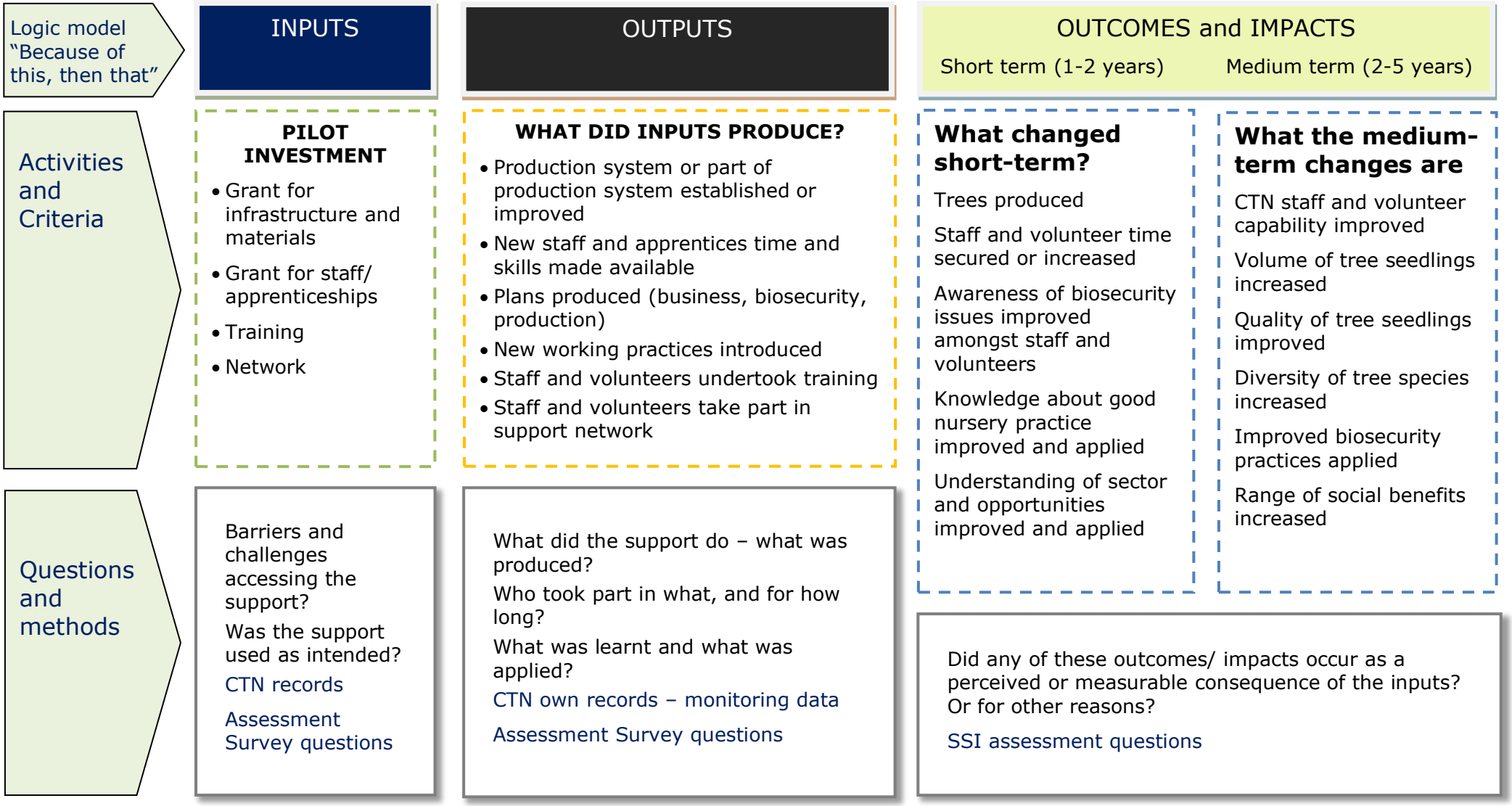
Step 1. Agree an Evaluation Framework

Develop and agree a simple evaluation framework in the form of a simple summary logic model. This will illustrate the basic "if-this, then-that" logic and identify the key outputs

[2] (20+) Community Tree Nursery Collaborative (UK) | Facebook and (20+) Fellowship of the Trees | Facebook

and potential short-term outcomes/impacts of interest to the *Boosting Community Tree Nurseries* pilot. The suggested evaluation framework is shown in Figure 8 below.

Figure 8. Evaluation Framework for Boosting Community Tree Nurseries pilot CTNs



Step 2. Agree a pilot project CTN assessment methodology

Evaluations measure and describe achievement of actual outcome over a specific time period, which may be in the short, medium and long term. Evaluations would generally look to provide a quantitative judgement of achievement across a programme, using empirical data to measure and attribute outcomes. Questions that an evaluation would answer include:

- what was done and when across the projects/ programme?
- what are the measured impacts and outcomes?
- what degree of change does this represent?
- looking at the outcomes and the original aims/goals, were the projects/programme a success?

An **Assessment** focuses on an individual case, i.e. a CTN, measures what is measurable and uses this to describe a situation and discuss change. Data can be qualitative and speculative as well as quantitative and empirical. Assessments are normally case and execution or process oriented. Questions that an assessment would cover include:

- what was done within the case?
- how was this achieved, what were the critical factors?
- where were the areas of difficulty and potential future improvement?
- what's the *likely* or *expected* impact?

Because of the difficulty of evolving SMART indicators associated with the project interventions and outcomes (e.g. measuring all the aspects related to tree quality, or finding a measure that grant funding for say fencing and attributable impact on tree quality), the lack of baseline against which to measure change (most of the CTNs are new and establishing), and the short time frame available to measure any changes that might be attributable to the pilot project interventions (a production cycle is likely to take 2-3 years) the most appropriate methodological approach would be to conduct an assessment rather than an evaluation.

Following through what is illustrated in the Framework (see Figure 8) the proposal is to:

- Assess 20 CTNs that have received support through the pilot project
- Undertake the assessment in the form of:
  i. **Assessment survey** – administered using Survey Monkey or similar, to collect basic monitoring data about pilot project interventions and outputs, the process of accessing the pilot project processes, and basic CTN initiative indicators (e.g. size of initiative, initiative costs, number of volunteers, planning documents, actual or expected production techniques).

ii. **Semi-structured interview** – administered through site visit or on-line interaction, to collect detailed qualitative evidence of how the interventions were received and applied, what the perceived and felt impact of those is, and whether there are other reasons that have contributed to changes and developments to the CTN. These interviews could also assess what challenges and barriers were still being experienced and where additional support could potentially make a difference.

Together both types of data would give a picture of:

- The CTNs experience of accessing the pilot project support.
- How the pilot project CTNs had used the support provided.
- What difference the CTNs perceived the support to have made.
- Where the CTNs were experiencing success or facing challenges and barriers.
- How any future support might be designed and delivered.

The Assessment survey would be completed at a point at which the CTNs had received, implemented and/ or actually used the pilot project support.

The semi-structured interview would be conducted as late into the contracted evaluation period as possible to ensure any impacts and outcomes attributable to the pilot project interventions could have emerged.

The speed at which interventions have been or are being awarded and disbursed varies by CTN, so a timetable would need to be agreed with the *Boosting Community Tree Nurseries* pilot project team to batch together CTNs for data collection in two data collection windows:

i. Spring 2022

ii. Autumn 2022

Integrating results and undertaking the analysis would be in the late autumn early winter of 2022, with final report submission and sign off in January 2023.

Step 3. Agree on the need for additional evidence to assess sector capacity for upscaling production

During the course of interactions with the *Boosting Community Tree Nurseries* pilot project team and the Steering Group for the ToW Project, there have been requests for information about the potential capacity within the sector to upscale and increase production. There have also been requests to understand more about what kind of CTN is sustainable in the longer term, and what the critical factors contributing to the success of a CTN is. The data and information that comes from an assessment of the pilot project CTNs following the methodology above will not provide these kinds of answers.

There is potential to engage the sector in a broader survey, delivered using Survey Monkey or similar, aimed at answering these specific questions. The sample could include those CTNs involved in the case study research described in this report, as well as the CTNs receiving support from the pilot project.

Such as survey could be designed to provide a sector-wide view of:

- the characteristics of CTNs across the sector (e.g. size, production volumes, types of tree produced, operating costs, volunteer numbers and contributions)
- reported trend data – production over time etc
- estimates of current production and potential for upscaling production, including opportunities and barriers/ challenges
- likelihood of upscaling, those who are or intend to increase volume, and which type of CTN, in which part of the country
- understanding of biosecurity, practices observed and biosecurity scheme membership
- how volunteers and others are engaged
- perceived benefits of volunteer engagement
- CTN training needs

Our proposal is to design the survey in Spring 2022, collect data in the early summer 2022, and analyse the data in the late summer early autumn 2022.

Analysis would be in the late autumn early winter of 2022, with final report submission and sign off in January 2023.

4 References

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Roshetko, J M, Tolentino, E L, Carandang, W M, Bertomeu, M, Tabbada, A, Manurung, G E S & Yao, C E 2010 *Tree Nursery Sourcebook* World Agroforestry Centre, Winrock International, University of Philippines Los Baños,, Nairobi, Kenya.

Appendix 1. Rapid Evidence Review: Annotated Bibliography

The bibliography is spilt into three parts as follows

- Toolkits and Guides about establishing and organising CTNs
- Academic papers : Nursery characterisation and performance
- Academic papers: Technical limitations experienced by small scale and community-based nurseries

Toolkits and Guides

1. **Jaenicke, H. (1999). Good tree nursery practices: practical guidelines for community nurseries Nairobi, Kenya International Centre for Research in Agroforestry.**

In the coming decade, farmers in the tropics will plant millions of trees in their fields. Twenty years ago most new trees on farms would have been wildings, nurtured wherever they germinated. What will change is that more trees will be deliberately planted in chosen niches on farms. Some of these plantings will be through direct sowing but in general they will come from seedlings or rooted cuttings raised in a nursery.

Research today into the domestication and performance of hundreds of agroforestry tree species is accompanying efforts to see the results of our research reach more people. The starting point for this is the tree, and the starting point for the tree is the nursery.

A great deal has been published about tree nurseries, but it concentrates on commercial plantation species. In this volume, the author has incorporated ideas and experiences from her own work and that of partners dealing with agroforestry tree species, and findings from published literature, to produce an invaluable technical guide.

Good tree nursery practices for research nurseries is more than a checklist of do’s and don’t’s for nursery managers and researchers. It presents concise but thorough information on all aspects of raising high-quality planting stock, with lists of contacts and nursery suppliers. In addition to general recipes and suggestions, tips are provided for developing specific nursery approaches to cater for the diversity of tree species, locations and nursery resources available.

By producing and using better quality tree seedlings in research nurseries, the results of such research will provide maximum benefit to small-scale farmers who

are planting trees. Farmers are asking for tree stock with good survival rates, fast early growth and predictability of performance. Researchers experimenting to meet these aims need to use high-quality planting materials.

Greater recognition of the role of good tree nursery practices and quality tree seedlings in ensuring sustainable and profitable agroforestry systems is needed. This manual aims to promote such recognition among researchers. A companion volume, Good tree nursery practices for community nurseries, aims to do the same among farmers, NGOs and community groups. Let us hope that they and others change the common slogan of "plant a tree" to "plant a quality seedling".

2. **Roshetko, J. M., et al. (2010). Tree Nursery Sourcebook. Nairobi, Kenya, World Agroforestry Centre, Winrock International, University of Philippines Los Baños.**

Tree nurseries are a key success factor in many forestry and agriculture development interventions. Over the last two decades, the World Agroforestry Centre (ICRAF), Winrock International, and University of Philippines Los Baños (UPLB) have worked with hundreds of small-scale and large-scale tree nurseries across Southeast Asia. Most of those nurseries were located in Indonesia and the Philippines. The purpose of the nurseries has varied from commercial biomass production, to land rehabilitation and forest conservation, to local capacity building and livelihood enhancement. Partners involved with operating those nurseries have included farmers, entrepreneurs, commercial firms, nongovernment organizations (NGOs), communities, projects, and government agencies.

The size, composition, and longevity of those nurseries have varied also. Individual- and family-run nurseries typically produced from 50 to several thousand seedlings/season. Large commercial or government nurseries produced 100,000 seedlings/season or more. On average group or community nurseries produced 10,000 seedlings/season. Simple backyard nurseries were often established with the resources that could be found locally. Most group and community nurseries were established with external support from projects, NGOs, or government agencies. Some large-scale commercial nurseries were established and operated with the latest state-of-the-art technology. Nursery production focused on timber species, MPTS (multiple purpose tree species), commodity crops (rubber, cacao, coffee, etc), or a combination of those species type. Many of the nurseries associated with projects, operated for 1 to 2 years, or ceased to exist after the project closed. However, many other nurseries evolved from project support to become independent self-sustaining and even commercial enterprises.

Through the experience of working with tree nurseries ICRAF, Winrock, and UPLB have had opportunity to assist hundreds of thousands of farmers, NGO and project staff, community workers, extension agents, researchers, and government officials enhance their technical capacity, establish successful tree nurseries, and contribute to land rehabilitation and livelihood enhancement. ICRAF, Winrock, and UPLB have

been enriched by the opportunity and gained profound understanding and insight regarding the development and evolution of tree nurseries as a component of national reforestation and tree planting programs.

This sourcebook was written to share the learning and insights from those experiences with a broader audience. It is not a technical manual. Rather the sourcebook provides interested individuals and organizations with sufficient information and general principles regarding the identification and development of the right type of nursery for their conditions. Readers are welcomed to use and share the sourcebook freely and encouraged to contact the authors with comments and inputs regarding the sourcebook or tree nurseries in general.

3. **Shanks, E. and J. Carter (1994). The Organisation of Small Scale Tree Nurseries. London, Overseas Development Institute.**

In the first of a series of rural development forestry guides, authors examine the managerial and organisational aspects of supporting small-scale nurseries and explore the benefits and advantages of decentralisation. Illustrated with case studies from Tanzania, Bolivia, Vietnam, Kenya, Nepal and Sudan.

4. **Dewis Gwyllt (2020). Setting Up a Small Scale Tree Nursery. Macynlleth, Wales Llais Y Goedwig.**

There is increased interest in collecting tree seeds by community woodland groups in Wales, to grow-on in small nurseries into seedlings or transplants. The purpose of this short guidance note is to provide a brief checklist of what is needed to grow small quantities of good quality native trees and to point readers towards relevant sources of more detailed information. It is mainly aimed at woodland managers, including community groups, who have collected their own local tree seed and wish to grow trees for their own use

5. **Wong, J. and B. Dickinson (2008). Business Planning Workbook for Local Provenance Tree Nurseries Bangor, Wales, Wild Resources Ltd.**

One of the first steps in the planning of a new enterprise or the expansion of an existing one is a careful appraisal of the opportunity in terms of costs and potential benefits. Conventionally this is done in monetary terms – that is as a financial appraisal of cash costs and income generation. The great range of production systems, available resources and objectives means that it is not possible to develop generic appraisals and it is necessary to undertake an appraisal that is specific to you. The lack of skills or know-how to undertake a financial appraisal is a significant barrier to many people considering nurseries as a business opportunity. In particular, most would like a realistic evaluation of start-up costs and reassurance that their business will be ultimately profitable.
However, costs can also be evaluated in terms of time, the way in which it prevents other activities taking place and benefits can be to fulfil an ambition to contribute to

woodland regeneration or to provide suitable employment for less-able workers. The workbook has been designed in recognition of a range of objectives other than income maximisation and leaves the final decision on whether a tree nursery is a viable opportunity to you. Nevertheless, it is important that you make your decision based on an appreciation of the financial implications of your venture to avoid unpleasant surprises!
The workbook is designed so you can work through it by yourself and provides sufficient background information to evaluate a tree nursery enterprise – however, it is NOT a nursery manual. Also, please be aware of the limitation of a self-help approach and the fact that prices and market conditions can change rapidly, so DO NOT make a decision based solely on the outcome of the workbook spreadsheets. DO seek follow-up professional advice such as that available from Glasu, Business Eye or a professional accountant before committing yourself to any course of action.
Additional online resources that you can consult for advice on starting up a new business can also be found on the Business Link website (www.businesslink.gov.uk).

Please note the following guides which are about growing trees from seed but do not touch on establishing and organising nurseries.

The Tree Council guides to raising trees from seeds and how to grow them:
https://treecouncil.org.uk/take-action/seasonal-campaigns/seed-gathering-season/growing-trees-from-seed/

The Woodland Trust guide to raising trees from seeds:
https://www.woodlandtrust.org.uk/plant-trees/advice/grow-from-seed/

The Conservation Volunteers guide to raising trees from seed:
https://treegrowing.tcv.org.uk/grow

The Conservation Volunteers guide to harvesting tree seed:

https://treegrowing.tcv.org.uk/wp-content/uploads/2019/09/handbook.pdf

The Forest Research guide to raising trees from seeds:
https://www.forestresearch.gov.uk/documents/1449/fcpg018.pdf

Academic papers: Nursery characterisation and performance

6. **Basweti, C., et al. (2001). Tree nursery trade in urban and peri-urban areas: A survey in Nairobi and Kiambu Districts, Kenya. Working Paper No. 13. Nairobi, Kenya, Regional Land Management Unit (RELMA), ICRAF, World Agroforestry Centre.**

The urban and peri-urban population in many developing countries is increasing at an alarming rate and it is projected that by 2015 the urban population will equal the rural one. Food and fodder insecurity is foreseen to accompany this increase. Agroforestry technologies can contribute to increased food and fodder production and minimized risks associated with small-scale agriculture, especially in the peri-urban setting. Tree nurseries play an important role in these areas and to understand their status, 39 nurseries were studied in urban and peri-urban Nairobi, Kenya, with the aim of understanding the technical and managerial nursery practices, germplasm pathways and the current economic situation of these nursery operations.
In the urban nurseries, 47 agroforestry tree species were encountered while the species in the periurban nurseries were 66. Most frequently encountered species - in declining order - in urban nurseries were Grevillea robusta, Dovyalis caffra and Casuarina equisetifolia, and in the peri-urban nurseries Dovyalis caffra, Grevillea robusta and Passiflora edulis. All nurseries visited were commercial enterprises. The majority (76%) of the urban nursery operators have no other source of income, whereas 76% of the peri-urban nurseries contributed between 5% and 90% of household income. Urban and peri-urban nurseries also differed in their approach to nursery management. Irrigation water was drawn from rivers by 36% of the peri-urban and only 11% of the urban nurseries. 30% of the urban nurseries used sewage water or road runoff for irrigation, none of the peri-urban nurseries did. Urban nursery operators generally had a higher education level than the peri-urban operators. Most prevalent constraints were access to water, germplasm availability and quality, and a lack of markets.
The total value of seedlings raised in the 39 surveyed nurseries in January and February 2000 was over USD 320,000.

7. Botha, J., et al. (2005). "A review of nurseries as conservation or social forestry outreach tools." International Journal of Biodiversity Science & Management 1(1): 33-51.

Conservation and social forestry outreach nurseries have been implemented extensively with local stakeholders internationally to achieve a variety of conservation and social forestry objectives. In this paper, key issues affecting the development of these projects are reviewed, starting with a brief overview of the development of people-centred approaches to natural resource management, followed by an examination of the concept of 'sustainability', which underpins most of these initiatives. A complex web of inter-related political, socio-economic and environmental factors influence the development of outreach projects, with the transdisciplinary nature of these initiatives posing substantial challenges at both research and implementation levels. A model is presented to facilitate the assessment of projects and the assumptions on which they are based. Management approaches, such as adaptive management, participatory methodologies and asset-based approaches are also discussed, as are group processes, which are seen to be

a hitherto neglected but critical part of project development. Although not all outreach nurseries aim to become commercially viable, many do, increasing challenges in implementation as a project must generate sufficient income in the long term to ensure its survival and to distribute satisfactory benefits to participants. The business attributes of outreach nurseries are compared with commercial sector enterprises.

8. **Botha, J., et al. (2007). "Commercial viability of conservation and social forestry outreach nurseries in South Africa." Agroforestry Systems 70(2): 135-156.**

Nurseries are risky ventures, even in conducive operating environments. Unlike many of their international counterparts, financial objectives are usually important to South African outreach nurseries, to generate funds for projects and/or to enhance local livelihoods. However, most are situated in low-income areas where residents have limited spending power. This paper examines the commercial viability of ten outreach nurseries from six provinces, with a range of conservation objectives. Management performance was assessed through correspondence and financial ratio analyses. Although seven projects had built up steady markets, this took 5–8 years to achieve, even in intensively funded projects. Only one nursery had achieved a steady annual net profit. The prolonged establishment phases impacted negatively on participants' livelihoods and project processes. Marketing difficulties included a lack of markets, nurseries being located far from markets, pricing difficulties, inadequate transport and limited marketing communications. Seasonal factors exacerbated liquidity shortfalls. Conservation activities such as greening and rehabilitation programmes provided markets, but medicinal plant nurseries struggled to achieve both conservation and socio-economic objectives, largely through difficulties experienced in providing seedlings at prices that subsistence sector resource users could afford. To achieve commercial viability, outreach enterprises need to adhere to business fundamentals viz. effective planning, management and coordination of resources, monitoring and control. Thorough viability studies are crucial. Alternate natural resource management and income generating strategies need to be evaluated, as a nursery may not be the best means of achieving these. The current Build–Operate–Transfer approach to projects by many supporting organisations is cause for concern as even small-scale projects usually require intensive support.

9. **Eisenman, T. S., et al. (2021). "Traits of a bloom: a nationwide survey of U.S. urban tree planting initiatives (TPIs)." Urban Forestry & Urban Greening 61: 127006.**

Municipal leaders worldwide are showing substantial interest in urban greening. This encompasses incentives, policies, and programs to vegetate urban landscapes, and it often includes urban tree planting initiatives (TPIs). Over the

past decade there has been a seven-fold increase in scholarly use of terms denoting TPIs, and roughly two-thirds of associated studies address TPIs in the United States (U.S.). This reflects a bloom of scholarly interest in TPIs. Yet, there has been limited research on contemporary TPIs as historically situated cultural phenomena, and there has to the best of our knowledge been no nationwide survey of TPIs across municipal scales. Addressing these gaps, this article presents findings from a survey of 41 TPIs in the United States. We report on typical traits of U.S. TPIs across six themes: background, dates and goals, public awareness, funding and governance, planting, and stewardship. Respondents identified over 115 traits that distinguish TPIs from typical urban tree planting activity, suggesting that TPIs are a discrete form of urban forestry. Over two-thirds of TPIs are funded separate from traditional urban forestry, and lack of institutionalization raises questions about long-term viability. TPIs mobilize political and financial resources for program launch, tree purchasing, and planting, but there may be a need for greater investment in stewardship activities and the social infrastructure that undergirds green infrastructure. Large shade trees for ecosystem services and native trees are the principal factors informing TPI species lists. Beautification and regulating ecosystem functions are, in turn, the principal potential benefits animating tree planting goals, yet few TPIs have conducted research to assess the fulfilment of associated outcomes. This study provides a foundation for future interdisciplinary scholarship on TPIs across the humanities, natural sciences, and social sciences.

10. Glowacki, T. (1989). Evaluating Village-Based Tree Nurseries in Senegal: A Comparative Study of Four Projects, Oregon State University,. Master of Science.

Reforestation projects in Senegal are often the vehicles which administer and implement social forestry activities. Their objectives are to help people solve their wood supply problems, enhance the environment by planting trees on farms and in villages, and introduce reforestation as a self-sustaining practice in village culture. Many projects establish village-based tree nurseries where community members grow seedlings to supplement or replace those supplied by government-owned regional nurseries. Village-based nurseries are promoted by the Division for Conservation of Soil and Reforestation and other Senegalese government agencies. This study, based on a survey of 32 villages, contained within four different projects: 1) investigates village-based tree nurseries in the Peanut Basin of Senegal by evaluating performance in terms of seedling survival and village nursery manager's intention-to-continue,2) compares the structure of four reforestation projects descriptively and quantitatively. Finally, it presents recommendations for future implementation of nursery projects.
Results indicate that village participation is a significant predictor for survival success. Three factors were significant predictors of intention-to-continue: previous nursery experience, water availability in the village, and the commercial sale of

seedlings by nursery managers. Analysis of these success factors provides insight into project organization.
Project extension strategies range from very structured methods to informal approaches. Awareness campaigns, field trips, and group training were variations found among projects in various mixes. Projects were similar in organizational structure, financial incentives, and encouragement of self-sustaining activities. Project design should include: 1) village participation from goal setting through evaluating results, 2) economic incentives that are based on encouraging the sale of seedlings, and 3) financing to improve water sources. Projects could also benefit from well-planned awareness campaigns, practical group training, and the application of more structured extension methods. Future studies are needed on villagers' behavior towards practice, adoption, and continuance.

11. Havyarimana, D., et al. (2019). "Constraints encountered by nursery operators in establishing agroforestry tree nurseries in Burundi." Agroforestry Systems 93(4): 1361-1375.

A nursery operator survey was conducted to identify major constraints encountered by nursery operators for tree nursery establishment in Burundi. The survey covered two main contrasting agro-ecological zones of the country in Muruta commune and Bugesera region in Bugabira and Busoni communes. It was found that most planting materials used by nursery operators were collected from sources of unknown genetic quality. It was also noted that few tree species were raised in nurseries of Muruta and Bugesera areas. The growing medium used in individual and group nurseries was of low quality. The lack of capital and nursery material inputs was another impediment to small-scale nursery sustainability. Most nursery operators lacked sufficient technical knowledge on nursery establishment techniques and had limited skills on vegetative propagation techniques. The low involvement of non-governmental organizations and government agencies impedes the sustainability of nursery operations in the two areas of study. Finally, the low demand and price for tree seedlings do not motivate nursery operators to produce seedlings for income generation. The government intervention may develop a well-structured nursery management system to support sustainable production of high-quality seedlings. It is then necessary to organize trainings of nursery operators on source and collection techniques of germplasm or planting material. The establishment of seed orchards and seed production areas of a large number of tree species is also of great importance. The support of nursery operators in financial and material inputs may promote tree species diversity and increase seedling production. The link of tree operators to good market may improve the sustainability of tree nursery operations.

12. He, J., et al. (2012). "Decentralization of Tree Seedling Supply Systems for Afforestation in the West of Yunnan Province, China." Small-scale Forestry 11(2): 147-166.

At present, China has the highest afforestation rate of any country or region in the world, with 47,000 km 2 of tree plantations undertaken in 2008. While the prominent role of the central government's afforestation programs is well-known, little is understood of how the system of tree seedling production and distribution supports afforestation efforts. More importantly, little attention is paid to how small-scale farmers access high quality tree germplasm in the afforestation programs. This paper examines the seedling supply system in the west of Yunnan Province in China by focusing on the three types of tree nurseries (state, collective and individual) that are being operated for the development of smallholder forestry especially in the context of decentralization. The research reveals that forestry decentralization has provided support for smallholder access to high quality planting materials and improved the effectiveness of nursery management. The reform has enabled the engagement of various forms of nurseries and created a hybrid system of state nursery operations. However, the state monopoly over the major seedling supply system using its inherent technical, market, policy and institutional advantages has limited the development of small-scale nurseries. The policy implication of this research is that improvements to the governance structure in the supply system of tree seedling may require more investment in nursery techniques, market information and provision of incentives to enhance small-scale nurseries and to contribute to seedling production. © 2011 Steve Harrison, John Herbohn.

13. Kututa, R. N. (2017). Factors Influencing Sustainability of Tree Nursery Projects in Public Primary Schools in Matuga Constituency Kwale County, Kenya, University of Nairobi. Master of Arts.

The study sought to examine the factors influencing sustainability of nursery tree projects in primary schools in Kwale County. The objectives of the study was: to assess influence of community participation on sustainability of tree nursery projects; to establish influence of training on sustainability of tree nursery projects; to determine financial administration practices influence on sustainability of tree nursery projects as well as evaluate how marketing strategies influence sustainability of the tree nursery projects in primary schools in Matuga constituency, Kwale county. The study used descriptive survey research design. The target population total being 500 people who benefitted from tree nursery fund in public primary schools in matuga constituency, kwale county. The sample size was 50 determined from a blend of stratified and systematic random sampling techniques while; data was collected by use of questionnaires. Data obtained from the field was sorted, edited and organized using statistical package of social sciences and the results presented using tables, frequencies, and percentages followed by a brief explanation. The study revealed that level of community

participation in Matuga constituency was generally low. Training of tree nursery project team was generally low which could have affected ability to manage nursery tree projects effectively. Financial practices and general handling of tree nursery project finances was wanting. The study found out that minimal marketing was carried out and prices were relatively low. The study recommends sensitization of the community to participate in such projects since they uplift the people's lives and change the environment they live in for their own good. Training that meets the specific needs of the people ought to be conducted before other similar programs are rolled out so as to thorough equip the community with the appropriate skills and gain confidence to tackle such projectss. There is need to be equipped with financial skills and that schools ought to intensify marketing for their products. There is also need to vary tree species in order to cater for varied needs of their clients. The findings of this study may be of benefit to the county government of Kwale as well as the national government in policy formulation in areas of implementing tree projects in schools.

14. Mercado, A. R. and C. Duque-Piñon (2008). "Tree Seedling Production Systems in Northern Mindanao, Philippines." Small-scale Forestry 7(3): 225-243.

This paper examines seedling production systems for small-scale forestry in northern Mindanao, particularly the constraints and opportunities to sustain the operation of smallholder nurseries. Various types of nurseries were identified to examine issues and concerns operators face, and data collected through a survey of nursery operators, discussion with government and NGO personnel, and literature review. Many smallholders in northern Mindanao have been engaged in seedling production, for farm needs and sale in local markets. The interest of smallholder to sustain seedling production depends on market demand and incentives, which translates to financial benefit on sound nursery practices and of reliable access to profitable markets. Activities that will assist smallholder nurseries to achieve full potential have been identified as: available nursery technologies to produce high quality planting materials in sufficient quantity; building farmer groups to facilitate seedling production and enhance the scale of product marketing; building partnerships with various service providers and other stakeholders to address technical, institutional, marketing and policy issues that may hamper the operation of smallholder nurseries; access to markets and market information; and provision of incentives and policy support. Associated benefits from small-scale seedling production accrue to the government, wood processors and to the public in general.

15. Molla, M., et al. (2020). "Socioeconomic contributions of small-scale private urban tree nurseries in Gondar and Bahirdar Cities." Cogent Food and Agriculture 6(1).

There is a growing interest to understand and establishment of urban tree nursery in Ethiopia and the horn of Africa. Socioeconomic contributions of urban tree nurseries, which are vital economic activities in major cities of Ethiopia in general and particularly in Bahirdar and Gondar cities are not adequately studied and well documented. Therefore, this study aims to evaluate socioeconomic contribution of urban small-scale tree nurseries and to evaluate the financial profitability of small-scale tree nurseries. Both qualitative and quantitative data were from primary and secondary source using urban tree nursery owner's survey, key informant interview and focused group discussion Qualitative data was analyzed descriptively, while financial analysis was conducted for quantitative data. The result revealed that urban tree seedling production was established recently government-owned land and handled by both male and female. On average 18920 ± 15990 and 15464 ± 13363 seedlings were produced per annum per individual in Bahir Dar and Gondar cities, respectively. Urban tree seedling producer in Gondar and Bahirdar generates an annual net profit of 338377–810183 ETB birr. Small-scale nurseries maintain the livelihoods of owners while creating permanent job opportunity to 1–2 jobless individuals per nursery site in both study cities. Generally, the result confirms urban nursery seedling production was profitable and potential business enterprise in the cities. The finding of the research is expected to contribute for the development of nursery expansion to the nursery owner. However, shortage of land for establishments of the nursery is constraining seedling production in the study areas. Therefore, actions such setting set land, during town planning is recommended to engage new entrepreneurs are some of the actions to be taken to strengthen the sector's development.

16. Mudyiwa, S. M., et al. (2015). "Characterisation of Urban Forest Nurseries: A Case Study of Harare Suburbs in Zimbabwe." Journal of Agricultural Science and Engineering 1(3): 101-107.

The study aimed to characterise urban forest nurseries with respect to nine Harare suburbs. Dzivarasekwa, Epworth and Kambuzuma represented high density suburbs, while the medium density was represented by Mabelreign, Waterfalls and Warren Park with Highlands, Chisipiti, and Mandara representing low density suburbs. Stratified random sampling was used to select the study sites. Data collection was carried out using structured and unstructured questionnaires, key informant interviews and observations. Data were analyzed using statistical package for social sciences (SPSS) version 16 through one way Analysis Of Variance (ANOVA). A total of 40 nurseries were identified within the suburbs and the key players in the business were individuals (83 %), non-governmental organisations and public organisations. There was a significant difference between the number of nurseries located in the high and medium density suburbs and those in the low density suburbs. Males dominated the trade (85 %) than women. Most

nurseries (65 %) were compliant in terms of registration though few could not meet the registration requirements. Nursery operators were constrained by finance, limited operational space, theft and irrigation water. It is recommended that training be done in nursery management. Associations can also be helpful in gaining recognition by City Council and EMA and this can harness opportunities for thriving business.

17. Nguyen, V. D., et al. (2017). "Branching out to residential lands: Missions and strategies of five tree distribution programs in the U.S." Urban Forestry & Urban Greening 22: 24-35.

Residential lands constitute a major component of existing and possible tree canopy in many cities in the United States. To expand the urban forest on these lands, some municipalities and nonprofit organizations have launched residential yard tree distribution programs, also known as tree giveaway programs. This paper describes the operations of five tree distribution programs affiliated with the Urban Ecology Collaborative, a regional network for urban forestry professionals. We analyzed the programs' missions, strategies, and challenges as reported through surveys and interviews conducted with program staff. The programs were led by nonprofit organizations and municipal departments in New York City, NY; Baltimore, MD; Philadelphia, PA; Providence, RI; and Worcester, MA. These organizations focused their tree distribution efforts on private residential lands in response to ambitious tree canopy or planting campaign goals. We assessed these programs through the framework of urban forests as social-ecological systems and discuss the programs' biophysical, social and institutional contexts. Programs face principle-agent problems related to reliance on individual tree recipients to meet goals; their institutional strategies meant to ameliorate these problems varied. Differing organizational and partner resources influenced the programs' abilities to perform outreach and follow-up on tree performance. Programs attempted to connect with diverse neighborhoods through free trees, targeting areas with low existing canopy, and forging partnerships with local community groups. Given tree recipients' demand for smaller flowering or fruiting trees, as well as lack of resources for tree survival monitoring on private lands, program leaders appeared to have turned to social measures of success – spreading a positive message about trees and urban greening – as opposed to biophysical performance metrics. We conclude with suggestions for outcomes monitoring, whether those outcomes are social or biophysical, because monitoring is critical to the sustainability and adaptive management of residential tree programs.

18. Nieuwenhuis, M. and N. O'Connor (2000). "Challenges and opportunities for small-scale tree nurseries in the East African highlands." Unasylva 51(203): 56-60.

In the highland regions of East Africa, cultivated and managed trees have assumed an important place as one of the many land use options available to small landholders. Most of the seedlings planted by farmers are produced in local small-scale tree nurseries, which have an important role in the sustainable development of the local communities. This article reports on the results of an in-depth survey of the cultural, management and marketing practices in small-scale nurseries in the Murang'a District in the highlands of Kenya. The objective of the survey was to identify the constraints affecting the capacity of nurseries to produce the range and quality of seedlings needed to fulfil the many and varied functions of trees in the region. A number of recommendations are made on ways to help small-scale nursery owners and managers obtain the knowledge, skills and resources necessary to run their nurseries economically and efficiently.

19. Place, F., et al. (2004). "Assessing the factors underlying differences in achievements of farmer groups: methodological issues and empirical findings from the highlands of Central Kenya." Agricultural Systems 82(3): 257-272.

This paper examines the performance of rural-based community groups in Central Kenya and addresses the methodological issues and challenges faced in doing this. Performance measures included subjective and objective ratings of success, including more objectively verifiable measures at household and group levels, derived from a survey of 87 groups and 442 households within four sites. Empirical evidence regarding explanatory factors for relative performance levels is presented using a special sample of 40 groups involved in tree nursery activities, with both descriptive analysis and regression models. Collective action is desired and practised for many tasks. The incredible number, diversity and dynamic nature of groups make it difficult to standardise and measure achievement. Choice and level of performance measures matters in explaining differences in group achievement. Focusing on groups undertaking similar activities allows deeper analysis of performance drivers. Examining different types of groups engaged tree nurseries found that performance was not linked to any easy-to-measure group characteristic, implying that for this task dissemination need not be targeted towards particular types of groups.

20. The Next Field Ltd (2015). Great London Authority Community Tree Nurseries. London.

On setting out to research the potential for London to support a wider and stronger network of community tree nurseries as volunteer led social enterprises, the study adopts an enterprise led approach and broadly concludes that whilst there is evidence that the market for such enterprises has potential , further work across a range of marketing and business planning themes is required.

In assessing the market for CTNs, the report identifies a range of core markets for locally grown trees as well as secondary markets to support these enterprises. In relation to core business, the market is segmented by landowner as well as by function (i.e. parks, housing, highways, and HS, development etc) and this area requires further research using digital mapping (GIS). Arrange of secondary markets are identified, from training, employee leadership programmes and events through 2 innovative niche market opportunities from green walls to providing instant landscapes for commercial product launches. Financial analysis demonstrates the CTN trees could be marketed at a 90% premium over commercial suppliers, as long as this price point matches the added value that customers will place on locally grown trees. Overall, the report highlights that the market needs to be developed through a combination of a new planning to support planting from local provenance, be advocacy of the benefits of using locally sourced trees, and see grant funding to help stimulate demand. Having assessed the market for CTNs, the study then explores the complex issues around the benefits of planting local provenance trees when considered within the context of climatic change and the need to ensure that London's tree canopy is resilient with temperature changes of up to 5 degrees centigrade forecast by 2050. In making a number of recommendations relating to local Providence, including considering a broader interpretation to include seed from London's non-native tree population, the headline conclusion is that that the relief partners need to hold a conversation to assess how to balance the benefits of local provenance against the need to ensure canopy resilience.

After exploring some of the practical considerations to establish a viable Katie Ann, focusing on site assessment criteria presented using a risk register, the report looks at business planning for CTNs and covers a range of relevant themes including business models, finance, staffing (including volunteering), and governance options for individual enterprises. This section of the study also considers the spatial requirements of a CTN and seeks to extrapolate this to assess the amount of land and number of nurseries that might be supported across the capital. The conclusion of this analysis, and the financial modelling, is that further detailed work is required based on real business scenarios and there is no single model KTM that can currently be used to support business planning for a London wide network. And additional recommendation relates to the business planning and governance for the network as a whole common based on a coordinated and collaborative hub and spokes model to support each CTN.

The final section of the study addresses funding and fundraising and covers a range of headline themes around funding models and opportunities. In line with the recommendation to manage the expanded network around the CTN hub, the report recommends that the relief partners use their vast collective experience, strengths, and contacts to develop a coordinated fundraising strategy including protocols to explain how they will work together to develop and deliver the CTN programme. The report also highlights some progress and future potential were certain

prospective funders who were contacted as part of the study, including commercial, lottery and charitable organisations. Other recommendations cover new and sometimes innovative ways attract resources and finance linked to exploiting you market opportunities including crowdfunding social investment corporate social responsibility (CSR), citizen science, and tree banks to recycle trees affected by development.

Academic papers: Technical issues and limitations

21. Aldentun, Y. (2002). "Life cycle inventory of forest seedling production — from seed to regeneration site." Journal of Cleaner Production 10(1): 47-55.

The objectives of this study were to produce detailed life cycle inventory (LCI) data for forest seedling production and to analyse differences between production units. The study was part of a larger project designed to obtain LCI-data for wood production in Sweden, from seed to delivery of logs at industrial sites. Data were collected regarding the amount of energy and commodities used, and the emissions released to the atmosphere as a consequence of the seedling production were calculated. Four modern, medium-sized nurseries, typifying container seedling facilities in Sweden, were evaluated in the study. Site-specific data regarding energy and commodities were used in the calculations, together with figures collated in relevant databases and literature. The results showed that the use of energy, and the emissions generated, were larger per seedling in southern Sweden than in the north of the country, since the seedlings were larger in southern Sweden. The fossil fuels used for heating the greenhouses and for seedling transportation were the major sources of emissions.

22. Dedefo, K., et al. (2017). "Tree nursery and seed procurement characteristics influence on seedling quality in Oromia, Ethiopia." Forests, Trees and Livelihoods 26(2): 96-110.

Most tree nurseries in Ethiopia overemphasize mass seedling production to the expense of seedling quality. The study aimed at evaluating nursery characteristics and tree seed procurement approaches, and how these influenced seedling quality in eight purposively selected Woredas of Oromia region. A total of 169 respondents from government and non-government organizations, farmer nursery owners and development/extension agents and officers were interviewed. Seed quality was explored through assessing the seed supply sources, the type of seed source and mother tree selection, and the practices in seed physiological quality assessments. Our results revealed that over half (62.5%) of the nurseries were government owned, while 20% were NGO-run nurseries and the remaining 17.5% were owned by farmers. Nine challenges constraining tree seedling

production and leading to underperformance were identified, with the two major problems shared by all nursery types being lack of sufficient material and germplasm input and using seeds of low or unknown quality. Informal seed dealers were the main source of seeds (87.6%) for all the nursery types. On the other hand, nursery operator?s own seed collection was from any free-standing trees either planted or retained as these sources were easily accessible. Seeds were, on average, collected from few mother trees, implying a high probability of sourcing seeds of narrow genetic diversity. Analysis of variance revealed statistically significant differences in seedling germination among the different seed procurement approaches within the same seed type. The seeds obtained from formal seed dealers had the highest germination rates in both hard-coated (87.3%) and soft-coated (79.7%) seeds. Our findings suggest that there is need to improve the seed procurement and the seedling supply system through quality assurance of the seeds used in seedling production.

23. Jaenicke, H. (1999). Good tree nursery practices: practical guidelines for community nurseries Nairobi, Kenya International Centre for Research in Agroforestry,.

In the coming decade, farmers in the tropics will plant millions of trees in their fields. Twenty years ago most new trees on farms would have been wildings, nurtured wherever they germinated. What will change is that more trees will be deliberately planted in chosen niches on farms. Some of these plantings will be through direct sowing but in general they will come from seedlings or rooted cuttings raised in a nursery.
Research today into the domestication and performance of hundreds of agroforestry tree species is accompanying efforts to see the results of our research reach more people. The starting point for this is the tree, and the starting point for the tree is the nursery.
A great deal has been published about tree nurseries, but it concentrates on commercial plantation species. In this volume, the author has incorporated ideas and experiences from her own work and that of partners dealing with agroforestry tree species, and findings from published literature, to produce an invaluable technical guide.
Good tree nursery practices for research nurseries is more than a checklist of do’s and don’t’s for nursery managers and researchers. It presents concise but thorough information on all aspects of raising high-quality planting stock, with lists of contacts and nursery suppliers. In addition to general recipes and suggestions, tips are provided for developing specific nursery approaches to cater for the diversity of tree species, locations and nursery resources available.
By producing and using better quality tree seedlings in research nurseries, the results of such research will provide maximum benefit to small-scale farmers who are planting trees. Farmers are asking for tree stock with good survival rates, fast

early growth and predictability of performance. Researchers experimenting to meet these aims need to use high-quality planting materials.
Greater recognition of the role of good tree nursery practices and quality tree seedlings in ensuring sustainable and profitable agroforestry systems is needed. This manual aims to promote such recognition among researchers. A companion volume, Good tree nursery practices for community nurseries, aims to do the same among farmers, NGOs and community groups. Let us hope that they and others change the common slogan of "plant a tree" to "plant a quality seedling".

24. Kung'u, J. B., et al. (2008). "Effect of small-scale farmers' tree nursery growing medium on agroforestry tree seedlings' quality in Mt. Kenya region." Scientific Research and Essays 3(8): 359-364.

Low survival and slow growth rate of multipurpose trees and shrubs as a result of poor quality tree seedlings hamper efforts by small-scale farmers in development of effective agroforestry systems. These may be attributed to the chemical and physical properties of the soil growing media used. With the current high and growing demand for quality agroforestry trees and shrubs, farmers are increasingly raising planting stock on their farms. However, insufficient technical knowledge has often hindered success. Such growing media contribute to physical and chemical conditions that may be inappropriate for quality seedling development. Slow growth and survival rate lead to extra costs in replacement planting as well as delayed benefits. This study assessed the effect of chemical and physical properties of-farm tree nursery growing medium on Tamarindus indica seedling quality and growth rate. Compost based growing medium gave higher seed germination percentage as compared to sand and farm medium. Compost based growing medium also gave higher seedlings survival rate and height growth than sand and farm soil. It also gave seedlings with higher sturdiness quotient. The physical and chemical properties of on-farm tree nursery growing media that had the greatest influence on T. indica seedling quality were the aeration pore volume, total pore volume, wet bulk density, total nitrogen, organic carbon, magnesium and calcium © 2008 Academic Journals.

25. Lindqvist, H. and C. K. Ong (2005). "Using morphological characteristics for assessing seedling vitality in small-scale tree nurseries in Kenya." Agroforestry Systems 64(2): 89-98.

Small-scale tree nurseries are important in fulfilling the goals of reforestation and agroforestry implementation schemes in Kenya and other developing countries. The focus in seedling production has been on quantity, instead of quality, but a change can be seen in recent tree nursery manuals. These manuals are emphasising morphological characteristics as tools for assessing potential field performance of seedlings. However, morphological criteria are debatable and their value is questioned. A survey was carried out among tree nursery operators in the

Meru area, in the Eastern province of Kenya, to determine how operators perceived seedling vitality, and how they separated acceptable seedlings from those of poor vitality. Based on the survey, 3 pairs of criteria were chosen, size (tall versus small), colour (green versus yellowish), and sturdiness quotient (sturdy versus lanky). These criteria were tested on survival and growth in a field trial, a controlled bench trial, and in a root growth potential test. The results showed that the nursery operators were aware of quality differences in seedlings, but they did not cull accordingly. The results from the field trial showed that mango (Mangifera indica L.) performed poorly compared to grevillea (Grevillea robusta A. Cunn. ex. R. Br.), probably due to the high altitude. The altitudinal range for mango and grevillea are 0-1,200 m and 0-2,300 m, respectively, and the trial site was located on an altitude of 1,725 m. In grevillea, small seedlings grew better than tall in the field trial, but no differences could be found in the other trials. In mango, sturdy seedlings grew better than lanky ones in the field trial, while in the controlled trials tall seedlings grew better than small ones. The results showed that morphological characteristics as seedling quality assessment criteria could be unreliable as the effect differs with species and planting site. © Springer 2005.

26. Vogt, J. M., et al. (2015). "Explaining planted-tree survival and growth in urban neighborhoods: A social–ecological approach to studying recently-planted trees in Indianapolis." Landscape and Urban Planning 136: 130-143.

This research seeks to answer the question, what factors of the urban social–ecological system predict survival and growth of trees in nonprofit and neighbourhood tree-planting projects? The Ostrom social–ecological system framework and Clark and colleagues' model of urban forest sustainability inform our selection of variables in four categories in the social–ecological system; these categories are the trees, the biophysical environment, the community, and management institutions. We use tree inventory methods to collect data on the survival, growth, and the social–ecological growing environment of recently-planted street trees in Indianapolis, IN to answer our research question. We use a probit model to predict tree survival, and a linear regression model to predict tree growth rate. The following variables are positively related to tree success (survival and/or growth): ball-and-burlap or container packaging, a visible root flare, good overall condition rating, the size of the tree-planting project, planting area width, median household income, percent of renter occupied homes, resident tenure, prior tree planting experience, correct mulching, and a collective watering strategy. The following variables are negatively related to tree success: caliper at planting, crown dieback, and lower trunk damage. Additional variables measured have less clear connections to tree success and should be examined further. Given that models including variables from all four categories of the social–ecological system generally outperform models that exclude some components, we recommend that future

research on urban tree survival and growth should consider the holistic social–ecological systems context of the urban ecosystem.

27. Wattenhofer, D. J. and G. R. Johnson (2021). "Understanding why young urban trees die can improve future success." Urban Forestry & Urban Greening 64: 127247.

The first several years after planting a tree, referred to as the establishment period, are recognized to have the highest annual mortality rates; determining those factors that influence survival of young trees should be considered paramount. This research examined several factors that influence young urban tree mortality: nursery production type (i.e. bare root, gravel bed bare root, container, or balled and burlapped), tree taxa, planting location type, and "planted by" (i.e. "who" planted the tree). The results from this study supported several relationships between project variables and young tree mortality, most notably that trees planted as containerized or balled-and-burlapped rootstock types in boulevards and parks had significantly higher survival rates than bare-root trees. Nursery production type, tree planting location, and tree taxa all had statistically significant impacts on young tree mortality, but "planted by" was not significant. The highest mortality rates were experienced by all trees planted in park/public spaces. The conclusions of this research will help to fill gaps and build upon the existing body of literature that practitioners may draw from to make informed planting and care decisions.

Appendix 2. CTN case study interview guide

1. **About the CTN – a potted history**

1. **What were the key driver(s) leading to the creation of the CTN?**
- Objectives
- Individual/organisational motivations

2. **Can you explain more about how the CTN was established?**
- Who was involved?
- How was the land and other the other resources found/sourced?
- How were the people resources found and paid (or not paid)?
- Was there personal investment? i.e., a person's savings?
- Was there any reliance on specific grants or other forms of support?
- What were and are major costs of establishing and operating the CTN, e.g. land and building purchase, labour, admin, supplies, maintenance costs? (Could it be ranked by value and maybe estimated at least to the order of magnitude, e.g., in tens or hundreds of thousands?)

3. **Looking back over the years of operation what would you say have been the key challenges, and what types of support that have been required at different stages in the CTN development?**
- Early design and establishment
- Two or three years in
- What future challenges do you anticipate?
- Is there any information which would help the running of the CTN? Would any information or support have been useful in the past?

2. **Community Engagement and impacts of that**

1. **How is the community involved and who (what type of people) is involved in the CTN?**
- Has this changed over time?
- Volunteers/paid staff (how many? how are volunteers organised, e.g. regularity, level of responsibility?)
- Interns, apprentices, etc.

2. **Do you have specific objectives for the community engagement?**
- Have these been a requirement from funders?

3. **How do you feel the CTN benefits from community engagement (e.g. costs, plant quality)?**

4. **How do you feel the community benefits from engagement in the CTN?**
- Probe on the range of benefits, e.g.
- 1. Physical Health, 2. Mental Health, 3. Social and Cultural, 4. Nature Connection. 5. Changes in ASB. 6. Inclusion of under-represented groups. 7. Upskilling and employment.
- Are any of these measured or monitored?

3. **Growing and supplying trees**

1. **Please could you explain more about your tree growing/production process?**
    - How are tree products used? (for own/local projects/for sale/other)
- Who is involved at what stage and why (seeds, plants, growing, selling)?
- Production cycles (seeds (bought or collected) or bought in plants? Length of time)
- Who is being supplied? How do/did you make connections with people to supply?
- Do you see any potential to increase production and how could that be supported?
- Do you produce any products in addition to trees?

2. **What biosecurity measures/practices do you employ if any?**

- Seeds and Stock
- Water/Soil/Compost management systems
- Purchased peripherals
- Volunteers and visitors to the site
- Onward supply chain
- **Are you aware of any plant health legislation/regulations? (e.g. notifiable pests and diseases), risk register etc**
- Are you aware of or part of Plant Healthy or other schemes, e.g. UKISG (UK, Ireland Sourced & Grown)?
- What are your most important ongoing costs, and can you compete on price with products already available on the market?
- How do you set your price, and do you sell at breakeven/profit?
- If profit, how is that distributed (e.g., invested back into the CTN)?

4. **Business and governance model**

- Do you have any kind of business plan or forward operating plan? Who takes part in developing, reviewing or implementing this? / Do you have a plan with, e.g., vision and aims?
- Do you have a development plan or any other kind of strategic planning document? Who takes part in developing, reviewing or implementing this?
- How are you managed in terms of governance, do you have advisory and/or supervisory boards, and what are the accountability arrangements (e.g., annual community meeting)?
- Who makes the financial and other important day-to-day decisions for the CTN?
- Do you have any income other than trees? Any funding? If so, how has it been provided and how vital is/was it?

5. **Sustainability**

1. Do you see the CTN developing as a long-term enterprise, or is it something that has a limited lifespan e.g., connected with a project, person etc?
2. Are you actively developing (leadership and) succession planning (capacity, capability and motivation of individuals) to secure the future of the CTN?
3. How do you rate the financial sustainability of the CTN (income generation, reliance on grants)?
4. How do you rate the sustainability of your supply and production (sources, biosecurity, contracts)?

Appendix 3. Case study evidence record sheet

Case Study			
Interview date		**Length of interview**	
Interviewer		**Recording ID**	

Main points to come through from the research interview. An eye on summarising challenges and successes and also for begin to think about what the evaluation C&I are going to be.

1. **Summary history and timeline of the CTN. Key events and challenges**
2. **How the community are involved and what the key benefits are**
3. **How the CTN produces trees and what emphasis is given to biosecurity issues**
4. **How the CTN organises itself, who makes the decisions and how the community is involved**
5. **What are the key issues in the business model that may require intervention or guidance?**
6. **What are the main sustainability issues likely to impact longer term viability?**
7. **Were there any issues that seemed important to include in the Toolkit?**
8. **Were there any other issues that should be recorded?**

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