Working Paper

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Findings of a survey of planters, researchers and funders

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World Agroforestry

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Acronyms

AFR100	The African Forest Landscape Restoration Initiative
CIFOR	Center for International Forestry Research
GLF	Global Landscapes Forum
GGW	The Great Green Wall
ICRAF	World Agroforestry
PATSPO	Provision of Adequate Tree Seed Portfolio in Ethiopia project

About the authors

Sammy Carsan,* Ian Dawson, Roeland Kindt, Joyce Chege, Ramni Jamnadass and Lars Graudal work for World Agroforestry (ICRAF). Ian Dawson also works for Scotland's Rural College (SRUC), Edinburgh, Scotland and Lars Graudal for the University of Copenhagen, Copenhagen, Denmark. Jens-Peter Lillesø and Fabio Pedercini work for the University of Copenhagen.

The authors are interested in research and capacity building related to tree planting in forest landscape restoration, agroforestry and other tree-based systems. They have a particular interest in developing the 'tree seed systems' and decision-support tools that allow planners and growers to do tree planting better.

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Acknowledgements

This working paper is based on responses to an online survey on sourcing tree seed for forest landscape restoration, agroforestry and wider tree planting. The survey was completed by tree planters, researchers and funders. Those respondents who were willing to be identified (some respondents chose to remain anonymous) are listed in Appendix 2. We are very grateful for the contributions of all respondents. As authors, we take full responsibility for the interpretation of the survey responses as presented in this paper, including any deficiencies it may contain.

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Summary

Current tree-planting initiatives are not always successful in achieving their stated targets of biodiversity conservation, climate change mitigation and human livelihood improvement. This is in part due to a lack of attention to the proper sourcing of the tree seeds and seedlings that are used. In this working paper, we explore these sourcing issues by reporting on an online survey undertaken in 2021 with tree planters, researchers and funders.

The aim of this working paper is to assess the feasibility of redesigning the design templates of planting project proposals to include tree seed sourcing information, with the outcome of increasing support for improved sourcing practices. The survey results for 173 respondents (comprising 90 planters, 69 researchers and 14 funders collectively working globally, embracing the Global South and Global North) suggested that there is scope at the project design stage to require (potential) tree planters – who are applying for financial support to carry out tree planting – to explain how they will source tree seed. The majority of funders were willing to adopt such an approach, and most survey participants overall considered that it is important for tree planters to explain how they will undertake tree-seed sourcing.

Our survey also indicated that funders would like training to develop in-house capacity to evaluate fund applicants' descriptions of their tree-seed sourcing strategies. The survey furthermore showed that information on the expected performance and origin of seed is perceived to be key for evaluating these strategies, and support to planters in the form of practical guidelines on tree seed sourcing is considered important for creating a better sourcing strategy.

In addition, our survey provided important information on the 'messaging' needed to support better tree seed sourcing. Tree survival rates and livelihood benefits were considered by survey respondents to be key measures of planting success, with livelihood benefits particularly important in the Global South. Consequently, an area of improved messaging to support better tree seed sourcing is in explaining the relationship found, and known to researchers but perhaps not well communicated broadly, between higher tree seed quality and better tree performance. Another opportunity identified for improved messaging is to highlight the greater returns achieved on investing in high-quality tree seed sourcing, with these increased returns greatly outweighing the extra costs that survey participants considered are involved with such improved sourcing.

Our next step in implementing relevant seed sourcing norms will be consultation on the results of this survey with the funders and coordinators of major tree-planting initiatives.

Keywords
Forest landscape restoration, project proposal template, tree-planting project design, tree seed systems, tree seed sourcing.

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1 Introduction

1.1 General introduction

Recent emphasis on forest landscape restoration has led to a number of ambitious global initiatives. These include the Bonn Challenge that was initiated in 2011 and which seeks to bring 350 million hectares of degraded and deforested landscapes into restoration by 2030 (Bonn Challenge 2021). To help meet this target, a combination of facilitated natural regeneration and planting of trees and other vegetation is required. In Africa, for example, the Great Green Wall (GGW) initiative seeks to restore 100 million hectares of currently degraded land by 2030 through these means, with the specific methods being employed to do so depending on the particular location (GGW 2021).

However, current tree-planting initiatives are not always successful in achieving their stated targets of biodiversity conservation, climate change mitigation and human livelihood improvement (Holl and Brancalion 2020).

For example, tree planting has often had negative impacts on biodiversity, due to the incorrect species or mix of species being chosen for planting. Too much emphasis has been placed on a few non-native species and not enough on a broad range of indigenous trees that provide a good habit matrix for other plants and animals, and other organisms, to thrive. This was observed in the 'Grain-for-Green' tree-planting programme in China, which re-established around 28 million hectares of forest (or, at least, 'wooded land') between 1999 and 2013. Of this area, more than 80% was planted to monocultures, which, at a study location in south-central Sichuan, caused significant losses of bees and birds (Hua et al. 2016).

Carbon sequestration also suffers when only a few tree species are planted, as communities of mixed trees – rather than stands of single species – often have the highest potential for carbon capture (Liu et al. 2018).

Maintaining planted trees is important in the early stages of tree-based restoration, as ensuring survival through careful tending is a critical factor for overall success (Nef et al. 2021). Restoration initiatives have frequently floundered, however, when local people are not fully engaged in maintenance. This can occur when the benefits that local communities receive from planting (timber, food, fodder, etc.) are insufficient to ensure their continued involvement in maintaining and properly managing trees (Cernansky 2021).

For many tree species preferred by growers, there has also been a lack of attention to the specific sources of seeds and seedlings that are used during planting. Such attention includes ensuring that these materials are i) diverse at the genetic level (this diversity is, like species' diversity, important for the successful provision of products and environmental services; Whitham et al. 2006); ii) well matched to the planting environment (Alfaro et al. 2014); and iii) well considered for the particular planting purpose (e.g., Jalonen et al. 2018; Roshetko et al. 2018).

Insufficient attention to sourcing *the right tree for the right place and the right purpose* has had negative effects on people and the planet, felt both locally and globally. Limited availability of suitable tree-planting material and limited knowledge of what to plant where are both significant constraints for good tree planting (Graudal and Lillesø 2007). The need to focus on the availability of good quality tree planting material, and the matching of this planting material to site and planting purpose, has been known to tree researchers and commercial forestry planters for many years (e.g., Langlet 1971; Burdon 1977). However, forest landscape restoration initiatives over the last couple of decades seem, on the whole, to have missed out on the importance of these factors, though existing guidance on appropriate tree seed sourcing is now beginning to be repurposed specifically for restoration implementation (e.g., Pedrini and Dixon 2020) and some recent restoration conferences have focused on the topic (e.g., GLF 2020).

1.2 Our work to address tree seed system deficiencies

One of the purposes of our work – 'our' being the authors of this working paper and the institutions we represent – is to address the insufficient attention that has been given to the trees that need to be planted in tree-planting programmes. Specifically, we seek to address what should be grown where and how the required tree seeds and seedlings will be obtained and delivered to planting sites – both of the species to be planted and of the particular sources of any particular species of the seeds and seedlings to be used.

In the last decade, we have raised awareness of the deficiencies in current tree seed and seedling sourcing among the forest landscape restoration community and wider tree planters. In a recent comment piece in the journal *Science*, for example, the science journalist Rachel Cernansky took up this topic after interviews with us and our colleagues (Cernansky 2021). Her popular-style article detailed how the struggle to make headway with the GGW is due in part to constraints in tree seed and seedling sourcing. In her piece we elaborated on the challenges associated with sourcing and how the impacts of getting sourcing wrong is ultimately felt most by the planters themselves.

There are a number of ways to address sourcing problems and improve planting outcomes. These solutions include improving the availability of appropriate tree seed and seedling sources, increasing networking, and building the capacity of the different actors who are involved in seed and seedling supply. Our work on the topic of improving 'tree seed systems' (as defined in Box 1) is available in the literature (Gradual and Lillesø 2007; Lillesø et al. 2011; Nyoka et al. 2015; Lillesø et al. 2018; Lillesø et al. 2021). So too, in the literature and online, are the information resources that we have developed to improve current tree seed and seedling sourcing practices (e.g., Kindt et al. 2006; van Bruegel et al. 2015; Kindt et al. 2021; Schmidt et al. 2021).

The importance of addressing sourcing concerns cannot be overemphasized due to the planned reliance in the future on natural climate solutions to support cost-effective climate mitigation (Griscom et al. 2017) and the need at the same time to provide benefits to economies, biodiversity and human health (Rosenstock et al. 2019).

1.3 Conducting a survey on tree seed sourcing

In this working paper we report on a survey undertaken in 2021 with tree planters, researchers and funders, to explore tree seed sourcing issues for forest landscape restoration, agroforestry and wider tree planting.[1] In the survey, we asked questions that are related to best practice in tree seed sourcing. Our aim through the survey was to better understand what changes could be made at the design stage of tree-planting projects to support the implementation of improved sourcing practices.

Specifically, in our survey we sought to explore whether adopting measures that require 'fund applicants' to explain how they will source tree seed would be acceptable to the broad tree-planting community and, if so, what approach could be taken to implement these measures with the outcome of supporting improved seed quality. We define the term 'fund applicants' as the (potential) tree planters who are asking for financial support to carry out planting from public and private investors such as governments, businesses, international initiatives and foundations.

Our hypothesis is that adopting such measures has the potential to drive the improved availability of suitable tree seed for planting and the increased awareness of what to plant where. These benefits could extend beyond the confines of the specifically funded projects in question (whose designs would now specify tree seed sourcing strategies) to support broader improved outcomes.

The approach we are suggesting is a marked change from the current fund application process, as the design templates of tree-planting project proposals now in use rarely require information from fund applicants on tree seed sourcing. Our suggested approach is not the usual one of devising appropriate standards for implementation (this is relatively straightforward), but rather is about addressing the harder task of finding tangible solutions for implementing these standards, something which is increasingly recognized as a crucial issue (Voices 2020).

In the following sections, we describe the methods used for the survey and summarize its findings.

[1] Note that in the survey and in the remainder of this working paper we use the term 'seed' as shorthand to mean all planting material, whether seed, seedlings or vegetatively propagated materials.

Box 1. Defining tree seed systems

A tree seed system is the method applied by actors (in the system) to organize the collection and distribution of tree seeds and seedlings, extending from seed source identification to the planting of seedlings. This method varies from the ad hoc collection of seeds from whatever sources are available, to the coordinated collection of high-quality seeds. A well-organized system encompasses several elements: the basic practices of tree seed and seedling production, including the identification, establishment and maintenance of tree seed sources, the processing and storage of seed, and nursery propagation; the distribution of tree seeds and seedlings to growers, with guidance on their use and the approaches to monitor and communicate their performance; the roles, relationships and responsibilities of the different actors involved in tree seed and seedling supply; and the regulatory aspects of seed and seedling quality. The tree seed sources that are an integral part of the system may be forests, farmland, plantations, seed orchards or 'clonal' mother blocks (in this last case, for vegetative propagules of trees rather than for seeds; vegetative propagules are often used for fruit tree planting) (Lillesø et al. 2011).

Tree seed systems can be broadly categorized into 'formal' and 'informal' 'systems approaches'. The formal systems approach comprises public and private organizations with specialized designated roles in production, distribution or regulation. The informal systems approach is made up of private households, farmers and NGOs disseminating material amongst each other. The formal systems approach has sought to enhance productivity through a focus on a few, often exotic, plantation species. This approach is, however, inaccessible to smallholder growers, who don't have the means to get hold of the seed from the distant centralized suppliers who provide it. The informal systems approach has provided a broader range of tree species and is more accessible but often relies on seeds of low quality. Neither of the approaches currently meets the need to provide a broad mix of tree species for planting, with the supplied trees well matched to planting sites and planting purposes, and fulfilling livelihood goals and environmental requirements. The current context is one where growers often end up planting whatever tree seeds and seedlings they can find, regardless of how suboptimal these materials are – and they are often signficantly suboptimal (this is little changed from 15 years ago, as was outlined then by Graudal and Lillesø 2007).

To help drive improvements in tree seed systems, we have undertaken *ex ante* assessments of the economic and environmental benefits of good tree seed sourcing practice. These assessments indicate that modest investments to improve genetic quality can have significant benefits. For example, we have estimated that for the African Forest Landscape Restoration Initiative (AFR100), an extra cost per seedling invested in genetic quality of less than five percent could hold the following benefits: generate over USD 5 billion of extra income for tree growers; sequester 19 million more tonnes of carbon per annum; and annually save a further four million tonnes of soil from erosion (this is under only modest assumptions of uptake in the use of the improved planting materials) (Lillesø et al. 2021).

2 Methods

2.1 Reaching out to participants

Our survey (see Appendix 1) was completed by tree planters and others who organize tree planting, scientists researching trees and their planting, and funders of restoration, agroforestry and wider tree-planting projects.

To seek responses, a hyperlink to an online SurveyMonkey version of our survey was circulated to target participants. We used a variety of methods to reach potential participants. These included messages on relevant list servers (the Society for Ecological Restoration and the Ecological Society of America Ecologists Collaborating Online Listserv) and in the Center for International Forestry Research-World Agroforestry (CIFOR-ICRAF) newsletter; direct email contact with CIFOR and ICRAF colleagues, some of whom completed the survey and others of whom provided referrals that we then followed up; and mailings to the authors' personal and institutional (CIFOR and ICRAF) peer contact lists. Our overall reach included thousands of potential participants. However, with the exception of postings to list servers, this reach had a primarily tropical focus, as these are the focus regions of CIFOR's and ICRAF's work.

The first invitations to participate in the survey were sent out on 14 January 2021. A reminder to complete the survey was sent out to individual contacts between three and six weeks later, with the exact timing depending on the particular group of potential participants being contacted. The survey was closed on 4 June 2021, at which point responses were synthesized.

Our survey was designed to collect information on participants' views on tree seed sourcing and the measures that could be put in place to improve it. In particular, they were asked for their view on a possible requirement for a 'sourcing strategy' to be integrated into project proposal design documents (i.e., the document/proposal that an applicant for funding [the prospective planter] must normally complete when seeking investment from potential donors [to undertake planting]).

Each survey participant was asked in what geographical area(s) their organization worked and whether they identified their institution's role in tree planting as planting itself (planter), researching tree planting (researcher) or funding tree planting (funder). The variable of asking participants to self-identify into one of these three respondent categories enabled more targeted subsequent questions and provided an opportunity to compare different views. The remainder of the survey applied two different response formats. The first of these provided a series of five response options from which the participant ranked their answer. The second format asked for free text responses.

2.2 Compilation and analysis of data

We analyzed survey responses using two approaches. First, for rank questions, we converted the rankings of response options to rank scores. For each respondent, the ranks given to each question's options were assigned scores as follows: five points to the option ranked first; four points to the option

ranked second; three points to the option ranked third; two points to the option ranked fourth; and one point to the option ranked fifth (last). The average score across respondents for each option for each question (the combined rank score), for particular categories of respondent (e.g., funder, planter), was then plotted as a bar graph.

Second, to assess the statistical significance of the differences in rankings between response options for any particular respondent category, rank responses were modelled using the PlackettLuce package (version 0.4.0; Turner et al. 2020, 2021) in the R statistical environment (version 4.0.2; R Core Team 2020). Testing of significance was done in two directions: i) we estimated whether the first-ranked option was ranked significantly higher than each of the four other options; and ii) we estimated whether the fifth-ranked option was ranked significantly lower than each of the four other options.

For most calculations, we divided respondents into planter, researcher and funder categories (as detailed in Section 2.1). In some cases, however, we applied two other sets of respondent groupings. The first grouping assigned respondents to the global development zone where they worked. This was defined as either the Global South or the Global North, terms that are commonly used in the development literature. The second other categorization, which was only applied to respondents who worked in Africa, was to assign respondents to the groups 'Anglophone' or 'Francophone', based on the primary language of the nation in which they/their work was based. We made this distinction because we thought it might impact survey responses and our early view of the data indicated that a number of respondents fell into each of these two groups.

In the case of global development zone, the pool of respondents that could be analyzed was a subset of the entire respondent set because we only considered respondents whose work was based in *either* the Global South *or* in the Global North. In other words, respondents whose work was carried out in both zones were excluded.

In the African Anglophone or Francophone categories, only respondents whose (African) institutional country base had *either* English *or* French as their primary language were relevant for our categorization. Consequently, respondents that were based in non-anglophone or non-francophone countries were not included (e.g., Portuguese-speaking African nations were excluded [though were of course included in the broader analysis]). For current purposes, Cameroon was considered as a francophone nation (Cameroon has French- and English-speaking regions, but French is the most spoken of the two languages nationally).

3 Results and discussion

3.1 Overall response to the survey

In total, 227 responses to the survey were received. The respondents who were willing to be identified are indicated in Appendix 2.

Of the total respondents, 173 provided complete information on all the relevant rank response questions posed in the survey. We took (only) these 173 completed responses as the basis for all data compilation and analysis reported below. The anonymized raw data of these responses are available upon request from the authors.

Of the 173 respondents, 90 identified themselves as planter, 69 as researcher and 14 as funder. While coverage for the first two responder categories was therefore relatively high, funders were under-represented. The low sample size in this last case affected our ability to assign statistical significance to differences among funder rank option responses in our analysis.

The country bases of respondents' institutions – including the bases of regional offices, where known – are shown in Figure 1. Respondents were based in 53 nations.

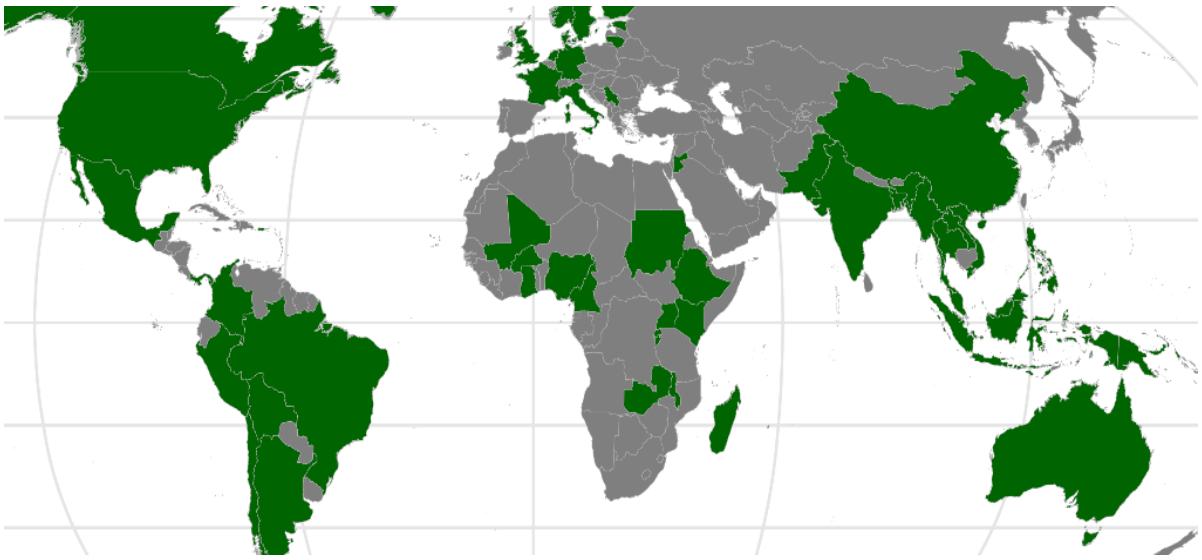

Figure 1. Country bases of survey respondents (country bases highlighted in green)

3.2 Geographical areas of work

Survey participants were asked the geographic areas in which they work, as follows:

"Please indicate all geographical areas where your organization works".

Respondents were allowed to choose one or multiple options from a list of geographic areas encompassing the globe. (It is important to note that where a respondent works is not the same as where a respondent's institution *is based* as reported in Figure 1: many institutions undertake work in a location other than their base or in multiple locations).

To compile geographic information and express the findings graphically, each respondent was assigned a total score of '1' for the geographic areas they indicated, and if a respondent worked in several geographic areas, their total score of 1 was partitioned equally across the areas indicated (i.e., a respondent working in two areas would be assigned a score of 0.5 for each area). Scores for each geographic area were than summed across respondents and expressed as a proportion of the total score for all areas combined.

A detail to note in the analysis is that the areas Caribbean, Central America and South America, which were indicated as separate options in the survey questionnaire, were subsequently merged into the single area of Latin America for reporting purposes. This merging was done before fractional scores were assigned to the geographic areas in which a respondent worked so as not to bias the overall comparison.

3.2.1 Summary of findings

Figure 2 shows the geographic areas where respondents work. These cover the globe, with Africa being the most common area and Asia the second. One feature of the analysis was the low 'planter' count for work being done in Europe. This can be attributed to our focus on individuals and institutions that work in tropical regions when sending out the survey (see Section 2.1). Each planter on average worked in 1.53 geographic regions, while the number was higher for each researcher (1.81) and for each funder (2.93). The greater area coverage for the last two categories of respondents may explain why they had more work in Europe than the planter category. The global reach of the list servers we used to publicize the survey, which are predominantly used by scientists, probably also explains the relatively high occurrence of work in Europe for the researcher respondent category in Figure 2.

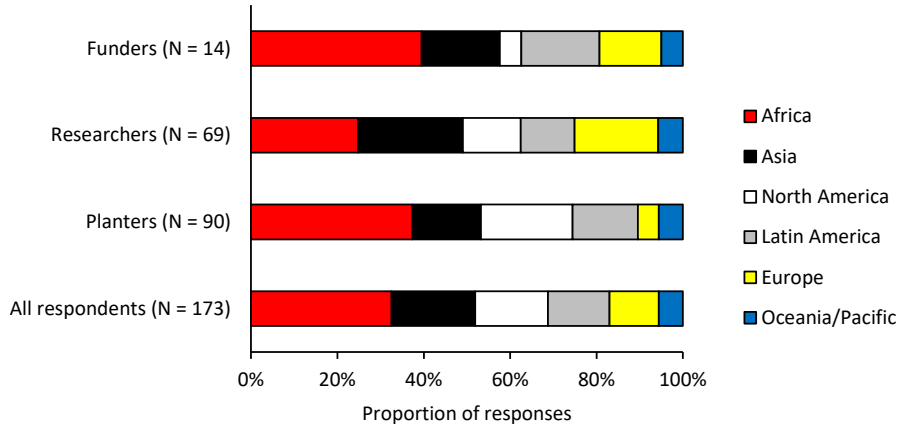

Figure 2. Geographic areas where survey respondents work

3.3 Most common way to obtain tree seed

Survey participants (only those who identified as planters) were asked the most common way they obtained tree seed as follows:

"What is the most common way that you obtain tree seed (and other tree-planting materials) for planting?"

Five options to be ranked were provided (see Appendix 1, Q8). Figures 3 and 4 indicate the results.

3.3.1 Findings for planters globally

For all planters together, **'own collection'** was the highest ranked option ($P < 0.01$ compared to all other response options) and **'international'** (seed sourced from outside the country) was the lowest ranked option ($P < 0.001$ compared to all other response options).

3.3.2 Findings for planters divided by global development zone

When considering the Global North and Global South as separate planter groups (Figure 4), again, as for all planters, for the Global North **own collection** had a significantly higher ranking compared to all other response options ($P < 0.001$ in all cases) and, again, **international** had a significantly lower ranking than all other response options ($P < 0.01$ minimum). For the Global South alone, although **own collection** was less favoured than for the Global North, it still statistically had a significantly higher ranking compared to all other response options within the Global South ($P < 0.05$ minimum) and, similarly, **international** had a significantly lower ranking than all other response options ($P < 0.001$).

3.3.3 Summary of findings

Our interpretation of the above data is that planters in both the Global North and the Global South rely heavily on seed (and/or other germplasm) they have collected themselves for tree planting. There is also a suggestion that in the Global North the reliance on self-collection is even greater than in the Global South. We had not anticipated this finding, given, nominally at least, the greater seed system infrastructure that exists to support tree planting in the Global North. It is possible that this infrastructure does not widely support restoration-oriented planting, but rather is geared to commercial plantation forestry enterprises that are based on a small range of tree species.

In other findings, the somewhat higher combined rank score of **'private enterprise'** (the use of private sector tree seed and seedling sources) by planters in the Global North may indicate a more important role for commercial suppliers there than in the Global South. Interestingly, in both contexts, planters somewhat value the role of **'government'** in seed supply. This could reflect the public ownership of forests and woodlands that are important tree seed sources.

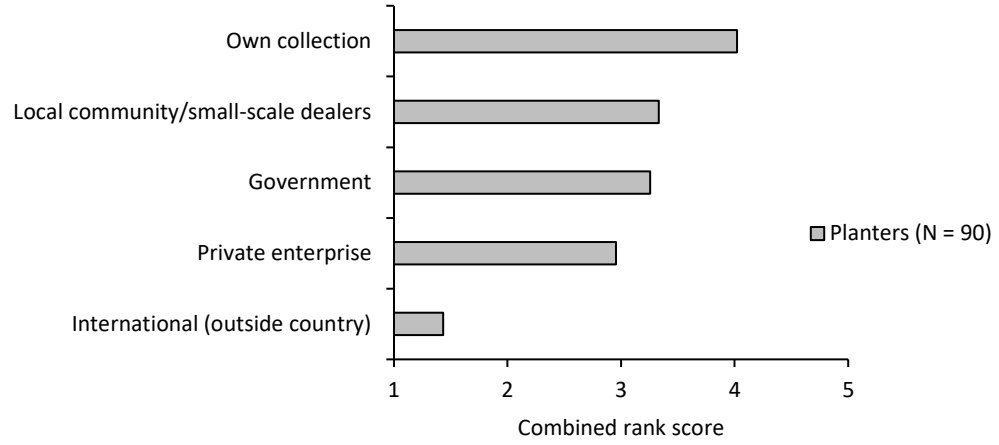

Figure 3. Planters' source of seed, ranking of five options

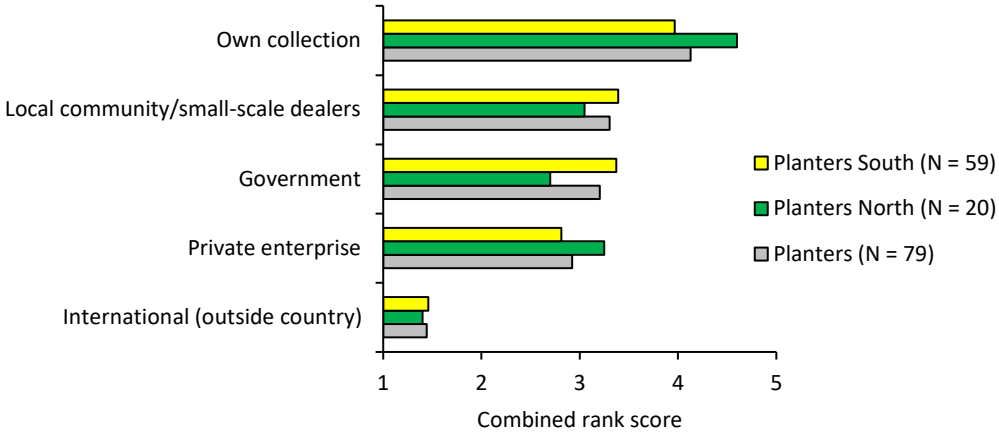

Figure 4. Planters' source of seed, ranking of five options, considered by the 'global development zone' of survey respondents

3.4 Willingness and support required by funders to assess fund applicants' tree seed sourcing strategies

Through a simple yes/no response option question, survey participants (only those who identified as funders) were initially asked whether they would be willing to request tree planters to explain how they intend to carry out their tree seed sourcing (see Appendix 1, Q9), as follows:

"As an institution that funds tree planting, would you be willing to ask those tree planters applying for your funds to show how they will carry out tree seed sourcing? This would mean fund applicants answering some questions on how they will source tree seed when they apply for funds from you…"

From the total of 14 funder respondents, 13 answered 'yes', indicating to us that there is recognition among funders of the importance of the sourcing issue and willingness to take action accordingly.

Survey participants (only those who identified as funders) were then asked what support they would need to assess planters' tree seed sourcing strategies, as follows:

"Let us assume that fund applicants are required to answer some questions on how they will source tree seed when they apply for funds from you. If so, what support would you as a funding body need in order to assess if applicants have developed a 'good' strategy for sourcing seed?"

Five options to be ranked were provided (see Appendix 1, Q10). Figure 5 shows the results.

'Training' (of funders, in tree seed sourcing quality standards) was identified as the highest ranked option. This option had a statistically significant higher ranking compared to **'independent advice'** (advice from independent experts) ($P < 0.01$) and **'scientific papers'** (that summarize appropriate technical standards) ($P < 0.05$), but the difference in ranking with the other two response options (**'checklist/guidelines'** [to assess applicants' responses] and **'formal criteria'** [quality standard criteria]) was not statistically significant. The lowest-ranked option of **'scientific papers'** had a significantly lower ranking than **'training'** ($P < 0.01$), while its difference in ranking with the other three response options was not statistically significant.

3.4.1 Summary of findings

Our interpretation of the above data is that funders would support fund applicants having to provide information on their tree seed sourcing strategies as part of the fund application process. Funders would, however, then prefer to build in-house capacity to evaluate fund applicants' sourcing strategies rather than delegate this role to outsiders. (We also note that the ability to interpret our data is limited by the relatively small number of funders sampled by our survey. Interpretation is also constrained by lack of clarity in meaning between some of the response options to our question on needed support [see Appendix 1, Q10], as informal feedback to our questionnaire suggested these options were some of the hardest to understand in the survey.)

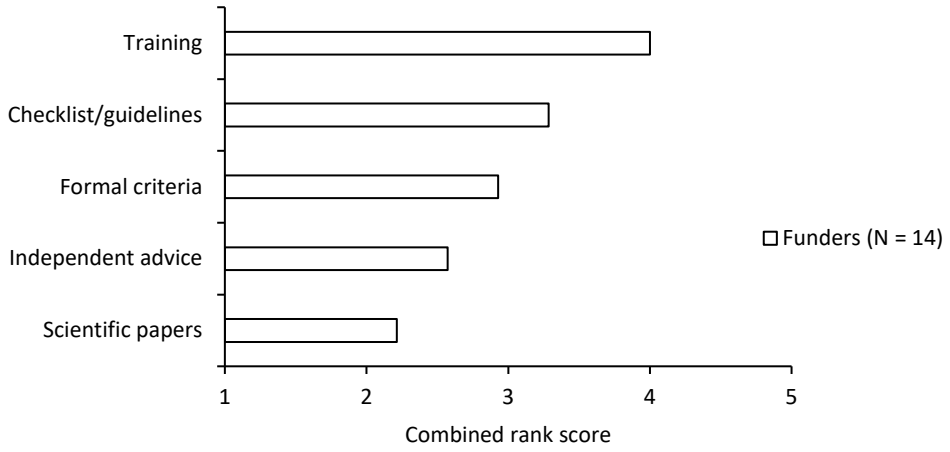

Figure 5. Support funders need to assess fund applicants' tree seed sourcing strategies, ranking of five options

3.5 Information needed by funders from prospective planters to assess tree seed sourcing strategy quality

Survey participants (only those who identified as funders and researchers [not planters]) were asked what information prospective planters applying for funds should provide to assess the quality of their tree seed sourcing strategies, as follows:

"Let us assume that tree planters are required to explain how they will source the tree seed that they intend to use for planting. (So that an assessment of the quality of tree seed sourcing is possible.) If this is so, how important is it for the planters to provide the different pieces of information below?"

Five options to be ranked were provided (see Appendix 1, Q11). Figure 6 indicates the results.

For funder and researcher respondent categories combined, the **'expected performance/matching'** of seed was the top-ranked option. This option statistically had a significantly higher ranking than **'supplier'** (who will supply the seed?) ($P < 0.001$), **'type of seed source'** (e.g., whether from natural forest, plantation or farmland) ($P < 0.01$) and **'species list'** (list of species to be planted) ($P < 0.05$). However, the difference in ranking with **'origin'** (the **'provenance'** or **'variety'** of the seed) was not statistically significant. **Supplier** was statistically significantly the lowest-ranked option compared to all other response options ($P < 0.001$ in all cases).

When considering researcher and funder respondent categories separately, a difference in the ranking of response options was observed. Researchers top-ranked **origin**, which had a significantly higher ranking compared to **supplier** ($P < 0.001$), to **type of seed source** ($P < 0.001$) and to **species list** ($P < 0.05$), but not to **expected performance/matching**. The **supplier** option, as for funder and researcher respondents combined, had a statistically significantly lower rank than all other response options ($P < 0.001$ in all cases). When considering funders alone, **expected performance/matching** was highest ranked, though statistically it had a significantly higher rank compared only to the **species list** option ($P < 0.05$). Conversely, **species list** was lowest ranked, but had a statistically significant lower ranking than the **expected performance/matching** option only ($P < 0.05$).

3.5.1 Summary of findings

Our interpretation of the above data is that – according to the researchers and funders of the global tree-planting community we reached – both the expected performance and origin of seed are key pieces of information for evaluating a tree seed sourcing strategy. This therefore suggests that applicants for tree-planting funds should be asked to provide information on both these points, assuming that documentation on their seed sourcing strategy is made part of the project proposal template.

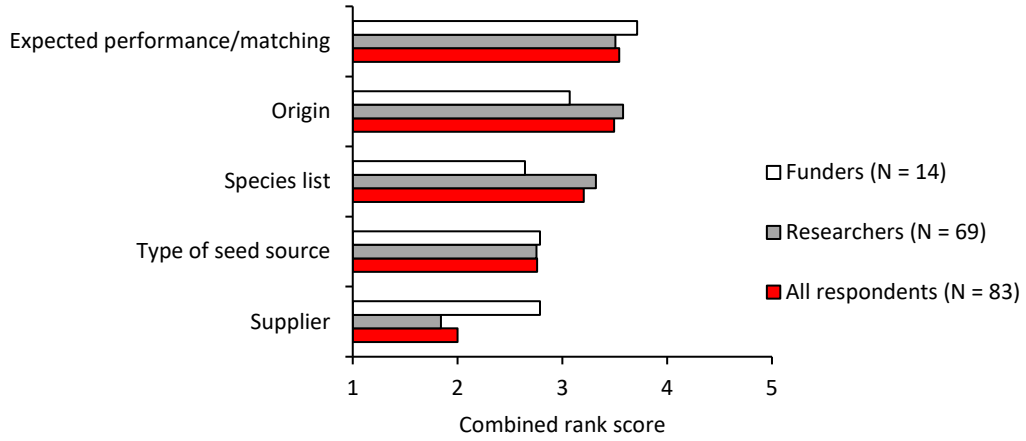

Figure 6. Information needed by funders to assess fund applicants' tree seed sourcing strategies, ranking of five options, considered by category of survey respondent

3.6 Appropriate measures of planting success

All survey participants were asked what would be appropriate measures of success in a tree-planting project, as follows:

"How important are each of the measures below in deciding whether a tree-planting project is successful?"

Five options to be ranked were provided (see Appendix 1, Q12). Figures 7 and 8 show the results.

3.6.1 Findings for respondents globally

For all respondent categories combined (Figure 7), **'high survival'** during establishment (which embraces minimizing the costs of ensuring survival) was the highest-ranked response option. This ranked statistically significantly higher than all other response options ($P < 0.01$ minimum). **'Known origin'** (a greater proportion of trees of documented origin) was the lowest-ranked response option, with a statistically significant lower ranking than all four other options ($P < 0.001$ in all cases).

When considering respondents by the separate categories of planter, researcher and funder, rankings sometimes varied from the overall pooled responses. For planters and researchers, **high survival** continued to be the first-ranked option, with a statistically significant higher ranking than all other response options (sometimes though the differences were of lower significance than for the overall pool of respondents, $P < 0.05$ minimum). Again, **known origin** was the lowest-ranked response option, with a statistically significant lower ranking than all other options ($P < 0.001$ in all cases). For funders alone, however, **'high livelihood benefits'** (from the established trees) ranked first, with a statistically significant higher ranking than all other response options except in the case of **high survival** ($P < 0.01$ minimum for the three cases where the rank difference was significant). As before, **known origin** ranked last, with a statistically significant lower ranking than all other response options ($P < 0.05$ minimum).

3.6.2 Findings for respondents divided by global development zone

When considering the Global North and the Global South as separate respondent groups (see Figure 8), **high survival** continued to be the first-ranked option in both groups. For the Global North alone, **high survival** had a statistically significant higher ranking than all four other response options ($P < 0.01$ minimum). For the Global South alone, however, **high survival** only had a statistically significant higher ranking than three of the other options ($P < 0.001$ in these three cases), as the rank difference with the **livelihood benefits** option was not significant. For both global development zone categories of respondents, **known origin** continued to rank last. For the Global North, this option, however, only had a statistically significant lower ranking than three of the other response options, as the rank difference with **livelihood benefits** was not significant ($P < 0.001$ for the three cases where the rank difference was significant). In the case of the Global South, **known origin** had a statistically significant lower ranking than all four other options ($P < 0.001$ in all cases).

3.6.3 Summary of findings

Our data therefore indicate that, among the response options offered by our survey, survival is widely considered the most important measure of success for tree-planting programmes, with the livelihood benefits achieved by growers a close second. However, the priority of these two measures of success is dependent on the respondent category, with some evidence that livelihood benefits are relatively more important to funders than planters and researchers, and in the Global South than in the Global North. The greater importance of livelihoods we identified for the Global South is consistent with growers there being more directly dependent on the products derived from trees.

The somewhat higher combined rank scores of **'high diversity'** (high tree species diversity established) and **'high environmental benefits'** (from the established trees) in the Global North than in the Global South (see Figure 8) are clearly a reflection of the interdependence between options' rank scores (i.e., if **livelihood benefits** is a more important measure of success in the Global South, then other measures of success must by default receive overall lower rank scores in that region), yet still suggest that ecosystem service provision is relatively more important in the Global North.

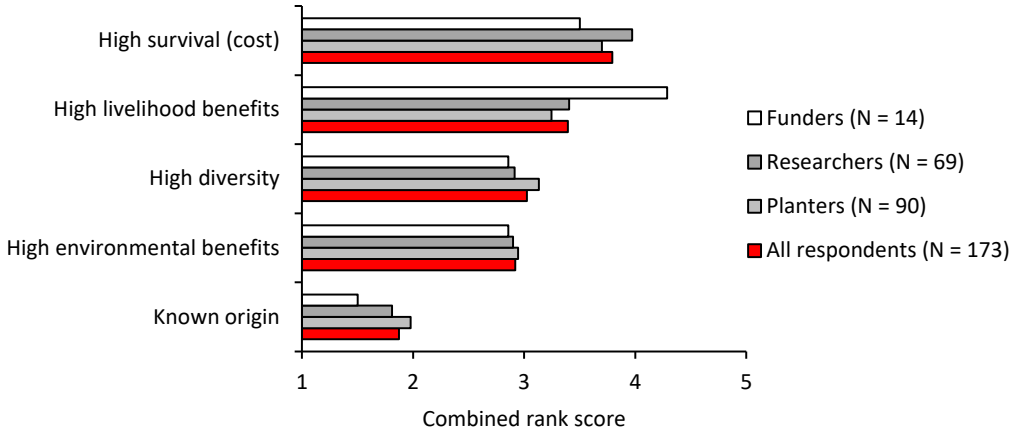

Figure 7. Important measures of tree-planting success, ranking of five options, considered by category of survey respondent

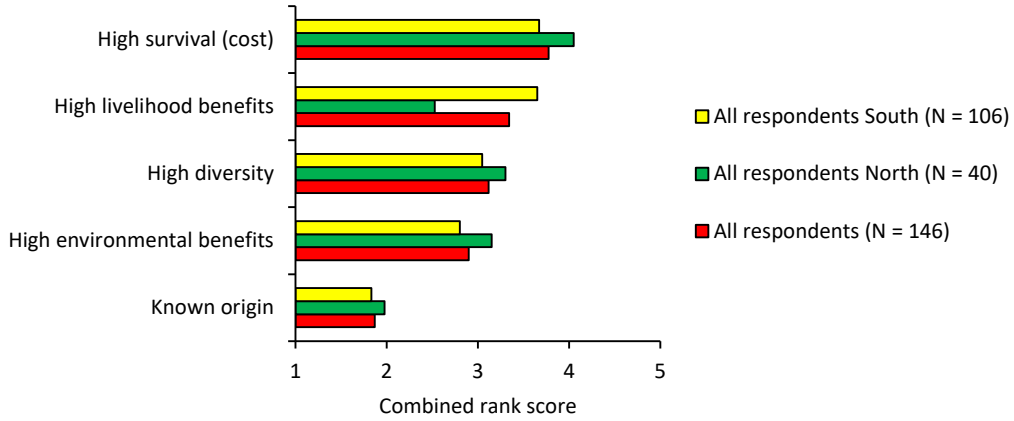

Figure 8. Important measures of tree-planting success, ranking of five options, considered by global development zone of survey respondents

3.7 Potential problems with requiring a tree seed sourcing strategy

All survey participants were asked what potential problems could occur in requiring prospective planters, applying for funds to carry out tree planting, to provide information on their tree seed sourcing strategies, as follows:

"Let us assume that tree planters are required to explain how they will source the tree seed that they intend to use for planting. (So that an assessment of the quality of tree seed sourcing is possible.) If this approach is followed it could lead to problems as well as benefits. Please rank…"

Five potential problem options to be ranked were provided (see Appendix 1, Q13). Figures 9 and 10 shows the results.

3.7.1 Findings for respondents globally

For all respondent categories combined (see Figure 9), **'too expensive'** (the cost to source good quality tree seed is too high) was the highest-ranked response option. This ranked statistically significantly higher than all other response options except for **'takes too long'** (which will unnecessarily delay the project) to source good quality seed ($P < 0.001$ for the three cases where the rank difference was significant). The lowest-ranked response option was '[it is] **not possible to source good quality**' (tree seed). This had a statistically significant lower ranking than all four other response options ($P < 0.001$ in all cases).

When considering respondents by the separate categories of planter, researcher and funder, rankings sometimes varied from the overall pooled responses. For planters alone, **too expensive** continued to be the first-ranked option, with a statistically significant higher ranking than all other response options, with the exception of **takes too long** ($P < 0.001$ for the three cases where the rank difference was significant). **Not possible to source good quality** also continued to be the lowest-ranked option, with a statistically significant lower ranking than all other response options ($P < 0.05$ minimum). For researchers alone, **too expensive** also remained the first-ranked option, with a statistically significant higher ranking than all four other response options, including **takes too long** ($P < 0.01$ minimum). **Not possible to source good quality** also remained the lowest-ranked option, with a statistically significant lower ranking than all other options except for **'don't know how to measure quality'** (don't know how to measure the benefits of using quality tree seed, so it won't be possible to understand if a focus on quality has made a difference) ($P < 0.01$ minimum for the three cases where the rank difference was significant). For funders alone, **don't know how to measure quality** was conversely the top-ranked perceived problem for quality seed sourcing; however, this option was not statistically significantly differently ranked from the other four options. For funders, **not possible to source good quality** was, as with other respondent categories, the lowest-ranked option. However, again there was no statistically significant difference in ranking between this option and the other four options.

3.7.2 Findings for respondents divided by global development zone

When considering the Global North and the Global South as separate respondent groups (see Figure 10), the overall rankings of response options in each case were the same as had been observed previously for all respondents (see Figure 9), and the patterns of statistical differences between top- and bottom-ranked response options and other options in each case were similar. The rank score profiles revealed for the Global North and the Global South showed very little difference from each other.

3.7.3 Summary of findings

Our data indicate that, from the response options offered in the survey, there is a broad perception that the (extra) financial cost of good quality tree seed sourcing is a key constraint. For the specific respondent category of funder, not knowing how seed quality can be assessed is a primary consideration. For planters, as well as cost, the (longer) time perceived to be needed to source good quality tree seed is considered to be a particular problem. Our results also indicate that perceived

priority problems associated with high quality tree seed sourcing do not differ significantly between the Global South and the Global North. This suggests that some of the interventions to address sourcing problems may be similar for these two global development zones.

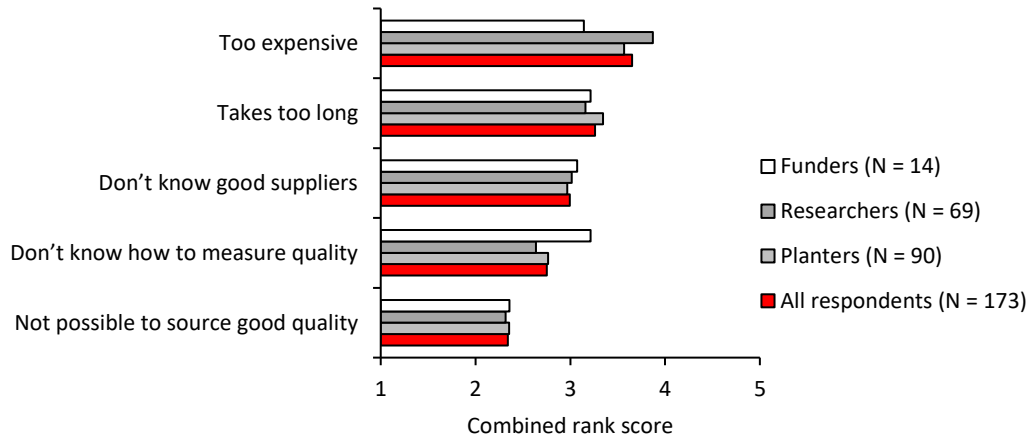

Figure 9. Possible problems with requiring a tree seed sourcing strategy from fund applicants, ranking of five options, considered by category of survey respondent

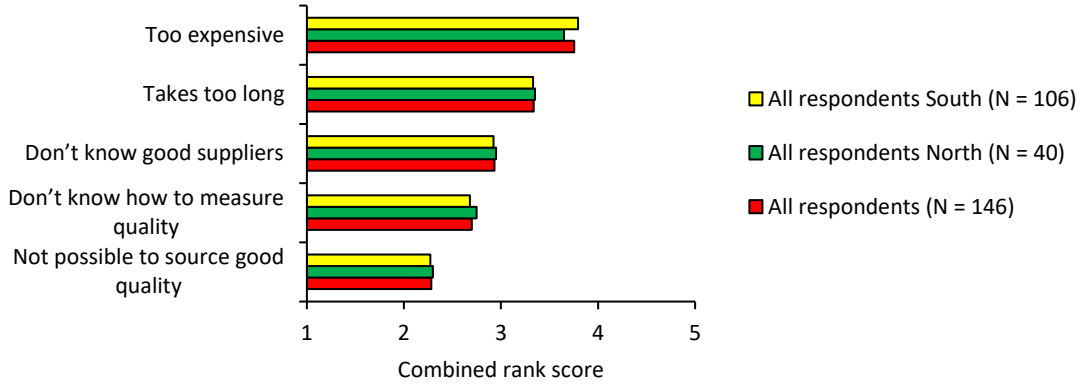

Figure 10. Possible problems with requiring a tree seed sourcing strategy from fund applicants, ranking of five options, considered by global development zone of survey respondents

3.8 Support for tree planters to develop a seed sourcing strategy

All survey participants were asked what forms of support would be most useful for tree planters to develop tree seed sourcing strategies, as follows:

"What forms of support would be most useful for tree planters to allow them to develop a good quality tree seed sourcing strategy?"

Five options to be ranked were provided (see Appendix 1, Q14). Figures 11 to 13 show the results.

3.8.1 Findings for respondents globally

For all respondent categories combined (see Figure 11), **'practical guidelines'** (on methods for collecting, producing and procuring tree seed) was the top-ranked option. This had a statistically significant higher ranking than all four other response options ($P < 0.001$ in all cases). The option of **'seed suppliers directory'** (a directory of tree seed suppliers) was the bottom-ranked of the five given options. This had a statistically significant lower ranking than all other options except for **'digital decision-support app'** (to indicate what tree species are suitable for planting at any given location) ($P < 0.01$ minimum for the three cases where the rank difference was significant).

When considering respondents by the separate categories of planter, researcher and funder, response rankings sometimes varied from the overall pooled responses. For planters alone, **practical guidelines** continued to be the first-ranked option, with a statistically significant higher ranking than all other response options ($P < 0.001$ in all cases). The option of **seed suppliers directory** continued to be lowest ranked, but the difference in ranking from other options was only significant with the **practical guidelines** option ($P < 0.001$). For researchers alone, **practical guidelines** also remained the first-ranked option, with a statistically significant higher ranking than all other response options except for **'technical standards'** (a list of scientific standards that represent best practice for tree seed sourcing) ($P < 0.05$ minimum for the three cases where the rank difference was significant). **Seed suppliers directory** also continued to rank last, with a statistically significant lower ranking than all other options except for **digital decision-support app** ($P < 0.001$ for the three cases where the rank difference was significant). For funders alone, practical guidelines also continued to rank top, although the difference in ranking with other options was only statistically significant with **seed suppliers directory** and **technical standards** ($P < 0.05$ minimum) and not for **'training courses'** (training by experts on how to source quality tree seed) or **digital decision-support app**. **Technical standards** was the lowest-ranked option for the funder respondent category, but the difference in ranking with other options was only statistically significant for **practical guidelines** ($P < 0.01$).

3.8.2 Findings for respondents divided by 'global development zone'

When considering the Global North and the Global South as separate respondent groups (see Figure 12), the top- and bottom-ranked response options were the same as for all respondents (see Figure 11) and as for each other (**practical guidelines**, top-ranked and **seed suppliers directory**, bottom-ranked). For both the Global North and the Global South the option **practical guidelines** was statistically significantly higher ranked than all other response options ($P < 0.01$ minimum). For both respondent groups, the **seed suppliers directory** option had a statistically significant lower ranking than **practical guidelines** ($P < 0.001$ in both cases). However, for the Global South there was an additional statistically significant difference in rank with **technical standards** and **training courses** ($P < 0.01$ minimum) (these comparisons not statistically significant for the Global North).

3.8.3 Findings for anglophone and francophone African respondents

We then considered responses for only African Anglophone and African Francophone participants in the survey (see Figure 13). For these respondents together (as a single group) the **practical guidelines**

option was highest-ranked (similar to findings in Figures 11 and 12) and the **digital decision-support app** option was lowest ranked (compared to **seed supplier directory** which ranked lowest previously for all respondents [see Figures 11 and 12]). The difference between **practical guidelines** as the top-ranked option and all four other response options was statistically significant ($P < 0.05$ minimum). The difference between **digital decision-support app** as the bottom-ranked option and other options was only statistically significant for **practical guidelines** and **training courses** ($P < 0.05$ minimum).

When considering African Anglophone and African Francophone respondents as separate respondent groups (see Figure 13), some differences in the ranking of response options was observed, though for francophone countries the sample size (N = 9) is small and findings should therefore be treated cautiously. In both cases, however, **practical guidelines** were the most important ranking and the **digital decision-support app** was the least important ranking. In terms of the significance of ranking differences, for anglophone nations the **practical guidelines** option (highest-ranked) had a significantly higher ranking compared to all four other response options ($P < 0.05$ minimum), while for the **digital decision support app** (lowest-ranked), the statistical significance was only compared to the **practical guidelines** ($P < 0.001$) option. For francophone nations, the practical guidelines option (again, highest-ranked) only had a statistically significantly higher ranking compared to the **digital decision support app** and technical standards options ($P < 0.05$ in both cases); while for the digital decision support app (again, lowest-ranked) statistical significance was (again) only compared to the **practical guidelines** option ($P < 0.001$).

Although our current analysis did not allow us to test the significance of the observed difference, one feature seen in Figure 13 that deserves mention is the difference between African Anglophone and African Francophone responses in the relative ranking of the **training courses** and **technical standards** options. **Training courses** appeared to be considered more important and **technical standards** less important in francophone countries than in anglophone ones.

3.8.4 Summary of findings

Our data therefore indicate that, from the response options offered in the survey, practical information on how to undertake tree seed sourcing is perceived to be the most useful form of support for planters. However, researchers also consider scientific standards that represent best practice for tree seed sourcing to be of high importance. (In practice, the difference between these options may be small and more about how the [same] information is packaged.) This priority for practical information on sourcing applied both in the Global North and the Global South, and, in the latter case, specifically in both African Anglophone and African Francophone nations. In Africa, data also suggest that offering training courses to planters on tree seed sourcing may be more important in francophone than anglophone countries. This could perhaps be due to guidelines and standards being more commonly published in English than in French.

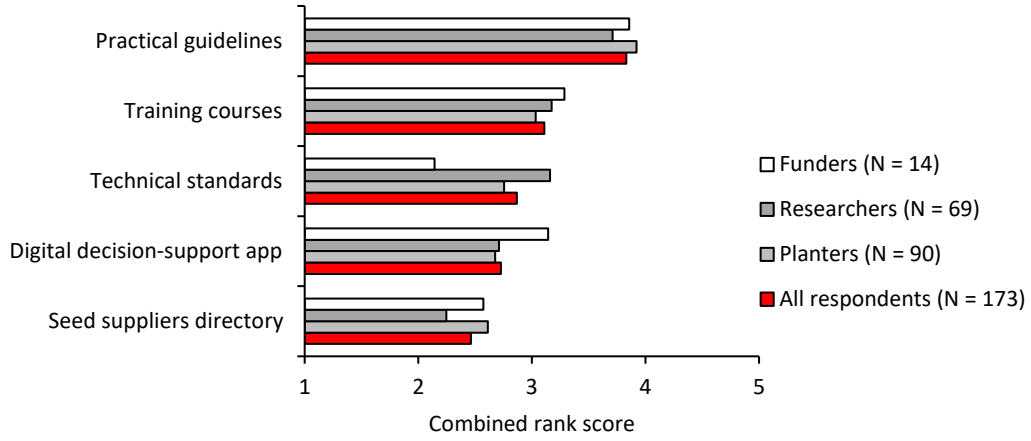

Figure 11. Important support for tree planters, ranking of five options, considered by category of survey respondent

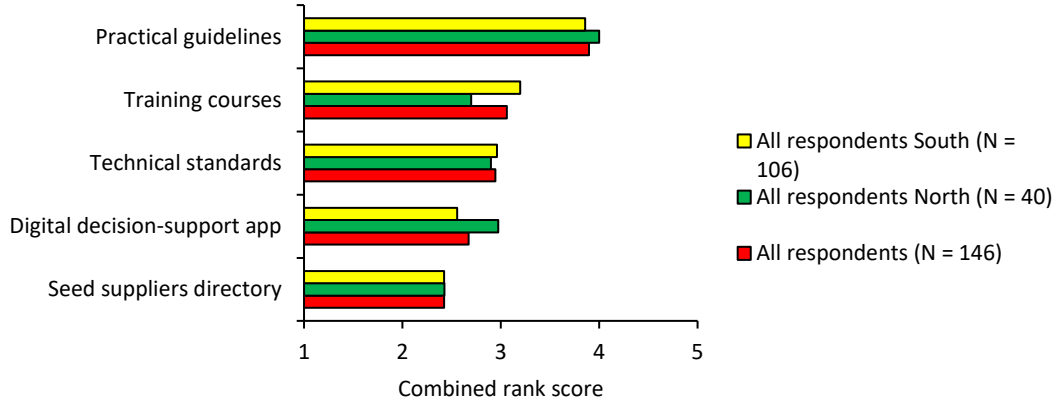

Figure 12. Important support for tree planters, ranking of five options, considered by global development zone of survey respondents

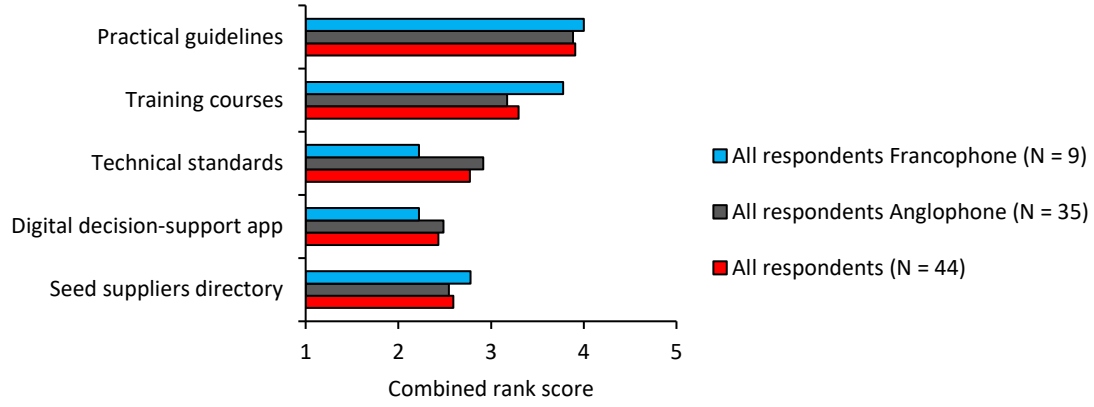

Figure 13. Important support for tree planters in Africa, ranking of five options, considered by nations' primary language of survey respondents

3.9 Support for the principle of a tree seed sourcing strategy

The final two questions of our survey (see Appendix 1, Q16 and Q17) asked participants if they considered it a good principle to require tree planters to explain how they will source tree seed for planting, as follows:

"Do you think that it is a good principle to require tree planters to have to explain how they will carry out tree seed sourcing? (So that an assessment of the quality of tree seed sourcing is possible.)" (This question required a yes/no response.); and:

"Please explain further your Yes or No response." (Free text response.)

Figure 14 shows the results of the yes/no response question for all respondents and different respondent categories. The results show that, regardless of the respondent group, a large majority of respondents agreed that it was a good principle to require tree planters to explain how they will source tree seed. The greatest proportion of 'No' responses (but still less than 20%) was from the planter respondent category.

Examination of free text responses to the second question above allowed us to understand the reasons for the small fraction of 'No' responses (i.e., that an explanation of tree seed sourcing should not be required from planters). The reasons given included that it could introduce barriers to participation in tree planting; was impractical to do so; was better to focus on 'incentives' rather than 'sticks' to develop better sourcing/planting practice; and the focus should rather be on broader actions to support planters.

3.9.1 Summary of findings

Our data indicate that there is broad support for asking tree planters to explain how they will source tree seed in order to promote better sourcing practice. (We interpret this to suggest that there are opportunities to ask for this information in project design documents [see Section 4]).

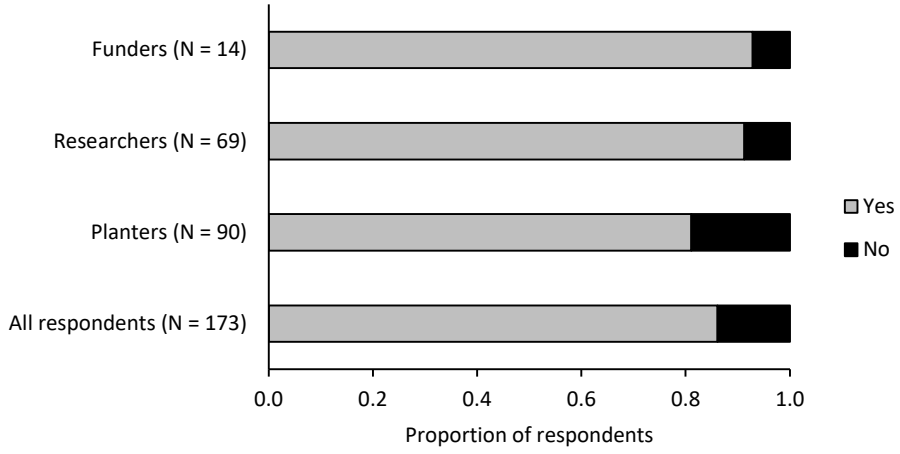

Figure 14. Respondents agreeing or disagreeing that it is a good principle to require tree planters to explain how they will carry out tree seed sourcing

4 Conclusion

In this working paper we have reported the results from a survey undertaken with tree planters, researchers and funders on the topic of tree seed sourcing for forest landscape restoration, agroforestry and wider tree planting. In addition to collecting information for planter, researcher and funder respondent groups, we explored results by the global development zone of respondents and whether respondents were based in anglophone or francophone Africa. Our aim in implementing the survey was to better understand what changes may be possible at the design stage of tree-planting projects in order to support better practice in tree seed sourcing, given that inadequate attention to sourcing is an important reason why tree-planting projects fail.

The results of our survey suggest that there is scope at the project design stage to require tree planters who are applying for financial support to explain how they will source tree seed. Our survey indicates that this would be appropriate in both the Global North and the Global South (though our concern as researchers working in the tropics is primarily for the latter). It also indicates what information on tree seed sourcing should be asked for in the project proposal template, what support funders would need to evaluate this information, and what support planters need to create a better sourcing strategy.

Our findings also particularly indicate where capacity building and extension support is required for the adoption of better seed sourcing practices, both within the funder and planter communities. In addition, our survey provides important information on the messaging needed to support better tree seed sourcing. In particular, it indicates the importance of messaging on the relationship between tree seed quality and tree performance – in terms of survival rates, livelihood benefits, and returns on investment.

Our survey represents only the first step in the implementation of seed sourcing norms in the development phase of tree-planting projects. Based on the results of this survey, consultation with the funders and coordinators of major tree-planting initiatives is now required and will be our next step.

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Appendix 1. Questionnaire used to obtain information on tree seed sourcing

(Explanatory notes to the questionnaire are added and highlighted in blue)

A survey on sourcing tree seed for forest landscape restoration, agroforestry and wider tree planting

This survey asks a short series of questions about tree seed sourcing for forest landscape restoration, agroforestry and wider tree planting. For the purposes of the survey, we use the term 'seed' to mean all sources of tree planting material, including seedlings and vegetatively-propagated material as well as seed.

In this survey, we ask questions that are related to 'best practice' in tree seed sourcing. Best practice in this case means choosing the 'right' tree species, 'provenances' or 'varieties' to plant for a particular planting site and purpose. If the right choices are not made it can have a significant negative impact on planting success.

Through this survey, we want to understand better what measures can be taken to improve tree seed sourcing. We are particularly interested to find out what changes could be made at the design stage of tree planting projects that would support improved sourcing.

Survey prepared by the 'Trees' group at ICRAF, within CIFOR-ICRAF (R.Jamnadass@cgiar.org - Theme TREEs: Tree productivity and Diversity - http://www.worldagroforestry.org/tree-diversity)

Q1. Your name:

[FREE TEXT RESPONSE]

Q2. Your institution:

[FREE TEXT RESPONSE]

Q3. Your email address:

[FREE TEXT RESPONSE]

Q4. Please indicate if you would be willing to be identified and acknowledged as having taken part in this survey or would prefer to remain anonymous:

O Willing to be identified and acknowledged

O Prefer to be anonymous

[EITHER/OR RESPONSE]

Q5. Please indicate if you would like to receive a summary of the results of this survey:

O Yes

O No

[EITHER/OR RESPONSE]

Q6. Please indicate all geographical areas where your organization works:

O Africa

O Asia

O The Caribbean

O Central America

O South America

O North America

O Oceania/Pacific

O Europe

[MUTIPLE OPTIONS POSSIBLE]

Q7. Please indicate the one option below that best describes your institution's role in tree planting. (If your institution does more than one role, choose that single role (only choose one role) that you personally can best represent for this survey.):

O My institution directly carries out and/or organizes tree planting (e.g., NGO, government extension) (= 'Planter')

O My institution does research on tree planting (e.g., university, government research, international research agency) (= 'Researcher')

O My institution funds tree planting (e.g., global funding provider, including public and private sectors) (= 'Funder')

[ONLY A SINGLE OPTION POSSIBLE] (The option chosen determined the list of subsequent 'rank' questions that the 'planter', 'researcher' or 'funder' participant was asked, as indicated below)

Q8. What is the most common way that you obtain tree seed (and other tree planting materials) for planting? Please rank between these 5 options (where 1 is the most important way of obtaining tree seed and 5 the least important – each option must have a different rank):

O We collect our own seed

O We get seed from a national or local government (parastatal) tree seed centre

O We get seed from a private enterprise

O We get seed from local community seed collectors, producers and/or small-scale dealers

O We get seed from an international supplier (outside the planting country)

(Only 'planters' were asked this question)

Q9. As an institution that funds tree planting, would you be willing to ask those tree planters applying for your funds to show how they will carry out tree seed sourcing? This would mean fund applicants answering some questions on how they will source tree seed when they apply for funds from you. How well these questions are addressed could determine whether or not their application for funding by you was successful.

O Yes

O No

[EITHER/OR RESPONSE] (Only 'funders' were asked this question)

Q10. Let us assume that fund applicants are required to answer some questions on how they will source tree seed when they apply for funds from you (i.e., 'yes' above). If so, what support would you as a funding body need in order to assess if applicants have developed a 'good' strategy for sourcing seed? Please rank between the below five options (where 1 is the most important support needed and 5 the least important – each option must have a different rank):

O Scientific papers summarizing appropriate technical standards

O Training in tree seed sourcing quality standards

O Application of formal quality standard criteria as for other safeguards

O Advice from independent experts from credible institutions

O Checklists with guidelines to assess applicants' responses

(Only 'funders' were asked this question)

Q11. Let us assume that tree planters are required to explain how they will source the tree seed that they intend to use for planting. (So that an assessment of the quality of tree seed sourcing is possible.) If this is so, how important is it for the planters to provide the different pieces of information below? Please rank between these 5 options (where 1 is the most important information planters should provide and 5 the least important – each option must have a different rank):

O The expected performance of seed at the chosen planting site (providing information on the 'match' between seed and site)

O The provenance (original collection site) or variety of the seed(s) to be used

O A list of species to be planted

O The type of seed source (e.g., from natural forest, plantation, farmland, seed orchard)

O The supplier of seed(s) (of each chosen species)

(Both 'researchers' and 'funders' were asked this question)

Q12. How important are each of the measures below in deciding whether a tree planting project is successful? Please rank between these 5 options (where 1 is the most important measure of success and 5 the least important – each option must have a different rank):

O Higher tree species diversity established

O Higher tree survival during establishment (and/or reduced costs in ensuring tree survival)

O Higher livelihood benefits from established trees (products for growers)

O A greater proportion of planted trees are of documented origin

O Higher environmental benefits from established trees

(All survey participants were asked this question)

Q13. Let us assume that tree planters are required to explain how they will source the tree seed that they intend to use for planting. (So that an assessment of the quality of tree seed sourcing is possible.) If this approach is followed it could lead to problems as well as benefits. Please rank between these 5 possible problem options (where 1 is the most important perceived problem and 5 the least important – each option must have a different rank):

O It is simply not possible to source good quality tree seed – it won't be possible to do tree planting

O Sourcing good quality tree seed is expensive – it will cost too much money to be practical

O Sourcing good quality tree seed takes too much time – it will unnecessarily delay the project

O We don't know how to measure the benefits of using quality tree seed – so we won't ever know if our attention to this made a difference

O We have no way of telling who are good suppliers of tree seed – suppliers may make misleading claims about quality

(All survey participants were asked this question)

Q14. What forms of support would be most useful for tree planters to allow them to develop a good quality tree seed sourcing strategy? Please rank between these 5 options (where 1 is the most important form of support and 5 the least important – each option must have a different rank):

O Practical guidelines on methods for collecting, producing and procuring tree seed

O A directory of tree seed suppliers

O A list of appropriate 'technical' scientific standards that represent best practice for tree seed sourcing

O Digital decision-support apps that indicate what tree species are suitable for planting where (site matching)

O Training courses by experts on how to source quality tree seed

(All survey participants were asked this question)

Q15. Is there anything else that you would like to add on the topic of how good practice in tree seed sourcing can be implemented (max. 100 characters)?

[FREE TEXT RESPONSE]

Q16. Do you think that it is a good principle to require tree planters to have to explain how they will carry out tree seed sourcing? (So that an assessment of the quality of tree seed sourcing is possible.)

O Yes

O No

[EITHER/OR RESPONSE]

Q17. Please explain further your Yes or No response (max. 100 characters):

[FREE TEXT RESPONSE]

Thank you for taking part in this survey.

___

Appendix 2. List of survey respondents who were willing to be identified

(Respondents are ordered by the date on which they answered the survey, earliest first.)

Given name	Given institution
Joyce Kasyoki	World Agroforestry (ICRAF)
Lisa Elena	World Agroforestry (ICRAF)
Prasad Hendre	World Agroforestry (ICRAF)
Robert Nasi	CIFOR-ICRAF
Madelon Lohbeck	Wageningen University, ICRAF
Prof. Dr. Kazi Kamrul Islam	Bangladesh Agricultural University
Fabio Pedercini	CIFOR-ICRAF
Ludy Keino	World Agroforestry (ICRAF)
geoffrey Abuor	CIFOR-ICRAF
Isaac Betserai Nyoka	World Agroforestry (ICRAF)
Gaiwa Daakréo	ICRAF Tchad
Aklilu Negussie Mekuria	WeForest
John Nyaga	One Acre Fund
Daniel Renison	ONG Ecosistemas argentinos
Adalsteinn Sigurgeirsson	Icelandic Forest Service
Ba Kaung (Mr.)	Ministry of Nat. Resources and Environ. Conservation, Myanmar
Throstur Eysteinsson	Icelandic Forest Service
Limbi Blessing Tata	Ecological Balance
Lucas José dos Santos	Grupo Ambiental Natureza Bela
Stanley J.Z Chitukwi	OSSEDI Malawi
KUH Emmanuel Loah	MIFACIG Training and Resource Centre
Anton Lata	Papua New Guinea Forest Research Institute
aris sudomo	Foerdea ministry of environment and forestry
Tambe Dickson Ashu	Elena Non-Governmental Organization
Jan Willem Nibbering	Embassy of the Netherlands in Burundi
Bernard Fungo	National Forestry Resources Research Institute (NaFORRI), NARO
Quiller Brooke	Gatsby Africa
Maha Mousa	WADI NGO
Josephine Makueti	GIZ/Eco-Consult
Jihad Zawaidah	Watershed & Development Initiative
Eric KAZUBWENGE	Rwanda Forestry Authority
Majd AbuSalem	WADI
Michael Geoffrey Likoswe	Forestry Research Institute of Malawi
Kahlil Baker	Taking Root
Raj Mohan	Sustainable Green Initiative
Charlene Wandera	Mount Kenya Trust
kevin Kiptoo	Gatsby Africa
Abubakar Ali Gambo	Yobe state college of Agriculture
Gunter Simon	GIZ
Pétur Halldórsson	Icelandic Forest Service - Skógræktin
Chris Harris	Shakti Reforestation
Lisa Riley	WildLands, Inc.
Chad Washburn	Naples Botanical Garden
Martin Breed	Flinders University

Given name	Given institution
Kara Barron	Gila Watershed Partnership
Munyuy Jacob Nyuykongi	Riba Agroforestry resource center
Lorene Lynn	Red Mountain Consulting LLC
Lincoln Kern	Practical Ecology Pty Ltd
Ken Hickson	Sustain Ability Showcase Asia
Trent Rhode	Living Landscapes
Mary Gartshore	Contract Ecological Restoration Specialist, Self-employed
Sridhar K B	Central Research Institute for Dryland Agriculture
Manoj Kumar	Verstegen Spices & Sauces B.V.
Satvant Kaur Saini	Iora Ecological Solutions, New Delhi
Varun Swamy	San Diego Zoo Institute for Conservation Research
John Whitelaw	Pichimahuida APP
Cheru Tessema	TREE AID
Dietmar Stoian	World Agroforestry (ICRAF)
Eduardo	ISA
RORY MACK	Gatsby Africa
Adriana Carla Dias Trevisan	Universidade Estadual do Rio Grande do Sul
Paul Kortebein	Three Rivers Park District
Brian Galligan	Naples Botanical Garden
Clement Chilima	Department of Forestry, Malawi
chris jensen	us forest service
Meredith Cobb	Five Rivers MetroParks
Dr Paul O. Anegbeh	Rubber Research Institute of Nigeria (RRIN)
Sean Fox	University of Guelph Arboretum
Panayoti Kelaidis	Denver Botanic Gardens
Rebecca Lieberg	Private contractor
Sam	Kenya Climate Smart Agricultural Project
Iftikhar ul hassan Farooqi	Forest Aervices Academy Ghoragali Murree Pakistan
Jeff Weiss	Living Lands Conservation Company
jaime rodrigo chamorro atiencia	consorcio desarrollo amazonica
Mike Gonzales	San Diego Canyonlands
Ricardo G. Cesar	University of São Paulo
Anko Stilma	Sicirec Bolivia
Justin Jonson	Threshold Environmental Pty Ltd
Innocent Julius TAULO	Forestry Research Institute of Malawi
Kimani Kibe	Future of Africa
Pol Cariño	PENAGMANNAK INC.
David Carr	Armidale Tree Group
Safaa Ahmed Beraima	Forest National Corporation
Stevenson Tan	Corteva Agriscience
Troy Pretzlaw	Parks Canada
Mclay Kanyangarara	COMESA
Usman Muhammad Mareri	Centre for Renewable Energy and action on Climate Change
Jill Hamilton	North Dakota State University
Hailey Paynter	Parks Canada
Sandra Vasquez	Fundación Pro Eco Azuero
Agnes Were	CIFOR-ICRAF
Maganizo Namoto	Forestry Research Institute of Malawi
Kristen King	NYC Department of Parks and Recreation
Innocent Julius TAULO	Forestry Research Institute of Malawi
Ingo Isernhagen	Embrapa

Given name	Given institution
Kuh Emmanuel Loah	Mixed Farming Common Initiative Group (MIFACIG)
Stephen Omondi	Kenya Forestry Research Institute
ard lengkeek	DIBcoop
Maimbo Malesu	CIFOR-ICRAF
Cathy Watson	CIFOR-ICRAF
NDYAMUHAKI ISAAC	EbaPreneur Solutions Uganda
Bangaoui Batadjomo Gervais	CREDI-ONG Cameroun
Desmond Nsobila Alugnoa	Green Africa Youth Organization
NDYAMUHAKI ISAAC	EBAPRENEUR SOLUTIONS UGANDA
Melissa Spearing	National Tree Seed Centre, Natural Resources Canada
Robin Van Loon	Camino Verde
Braden	Sylva Systems Pty Ltd
Fredrick Okinda	KOMB GREEN SOLUTIONS
EUNICE GITUKU	World Agroforestry (ICRAF)
Karen Holl	University of California, Santa Cruz
Tony Rinaudo	World Vision Australia
Dr R Aanandalakshmi	Institute of ForestGenetics and Tree Breeding, Coimbatore, INDIA
Henry Komu	KEFRI
Stephen Ndung'u	Kenya Forestry Research Institute
Grace Koech	CIFOR-ICRAF
Gaster Kiyingi	Tree Talk Plus
Simeon Nyango	Kenya forest service
Andre Lacerda	Embrapa Forestry
Anne Mbora	Center for Natural resources management
Will Sheldon	Taking Root
Dr. Samson Gwali	National Forestry Resources Research Institute, Uganda
Prof. Ris. Dr. Yulianti, MSi.	Forest Tree Seed Technology Research and Development Centre
Lishomwa Mulongwe	Forest Research Branch
Bernard Ngoda	Egerton University
Thuy Nguyen	Vietnamese Academy of Forest Sciences
Soud Mohammed Jumah	Zanzibar Natural resources and Climate change Forum (ZANAC)
Joel Buyinza	National Forestry Resources Research Institute (NaFORRI), Uganda
Violet Jessie Msukwa	Dedza District Forestry Office
Hillary Agaba	National Forestry Resources Research Institute
Diane Bagui	Forest Foundation Philippines
Konstantinos Mantzanas	School of Forestry and Natural Environ., Aristotle Univ. of Thessaloniki
Diedenhofen Thierry	Administration de la nature et des forêts Luxembourg
Jutta Buschbom	Statistical Genetics
Carrie Cimo	Boulder County Parks and Open Space
ZHENG Yongqi	Institute of Forestry, Chinese Academy of Forestry
Laura Morales	Recent past: The School for Field Studies
Crispen Marunda	Sustainable Timber Tasmania
Aoife Mac Namara	NSCAD
Frans Theilby	Seniors Without Borders
James M. Omambia	Makueni County Government
Armand ASSENG ZE	FAO
Romain KANA	Fondation Trinationale Sangha
Paul Karanja	Sustainable Agriculture Community Development Programme - SACDEP
Daniel Ndegwa	SACDEP KENYA
Stephen Cavers	UKCEH
Peter Misiko	SACDEP-Kenya

Given name	Given institution
Michael Muruga	NDEKA
Daniel Ofori	CSIR-Forestry Research Institute of Ghana
Hiwot Workagegnehu Tafere	GIZ
Patience Mansa Gakpetor	CSIR-Forestry Research Institute of Ghana
Pierluigi Paris	National Research Council- Institute on Terrestrial Ecosystems
Samantha Forbes	Mars Inc
Amanda L Gant	WRI
Anthony Antwi-Wiredu	CSIR-Forestry Research Institute of Ghana
Mike Janssen	Acacia Forest Industries Sdn. Bhd.
Gautier Queru	Mirova
Teddy Kinyanjui	Seedballs Kenya
james macdonald	Armstrong Apiaries
C. Ryan Smith	Conseil Régional de la Forêt Antisua (Antisua Forest Regional Council)
Aishwarya R	Forest by Hearfulness
Chetan Saraf	Aranyak
Daniel M'Mailutha	Kenya National Farmers' Federation (KENAFF)
BIERINX Caroline	Reforest'Action

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ICRAF is the only institution that does globally significant agroforestry research in and for all of the developing tropics. Knowledge produced by ICRAF enables governments, development agencies and farmers to utilize the power of trees to make farming and livelihoods more environmentally, socially and economically sustainable at multiple scales.

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