Working Paper

From Tree Planting to Tree Growing: Rethinking Ecosystem Restoration Through Trees

Lalisa Duguma, Peter Minang, Ermias Aynekulu, Sammy Carsan, Judith Nzyoka, Alagie Bah, Ramni Jamnadass

World Agroforestry

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United Nations Avenue
PO Box 30677, GPO 00100
Nairobi, Kenya
Tel: +254(0)20 7224000, via USA +1 650 833 6645
Fax: +254(0)20 7224001, via USA +1 650 833 6646
Email: worldagroforestry@cgiar.org
Website: www.worldagroforestry.org

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About the authors

Lalisa Duguma is a sustainable landscapes and integrated climate actions scientist at World Agroforestry (ICRAF), with vast experience in operationalising landscape-level interventions for the benefit of ecosystems and people. He has a PhD in Agricultural Sciences with emphasis on the agroforestry-deforestation-livelihood-sustainability nexus. His areas of interest include ecosystem-based adaptation, integrated climate actions in the land use sector, sustainable landscape management, greening humanitarian landscapes, and other related fields.

Peter Minang is a principal advisor and Theme Leader for Landscapes Governance at World Agroforestry (ICRAF), the Global Coordinator, ASB Partnership for the Tropical Forest Margins and the Flagship Leader, Landscapes – CGIAR Research Programme on Forests, Trees and Agroforestry (FTA). He has more than 25 years of experience working on conservation, community forestry, climate change, forestry, sustainable landscapes and ecosystem services in Africa, Latin America and Asia. His research interests include the nexus between adaptation and mitigation to climate change; and the interface between environmental services, development and multifunctional landscapes.

Ermias Aynekulu is a land health scientist at World Agroforestry (ICRAF), based in Nairobi, Kenya. His research focus lies on forestry, land degradation, landscape ecology, restoration ecology, soil carbon dynamics and spatial sciences to understand land health constraints and how to target interventions to sustain ecosystem services.

Sammy Carsan is an agroforestry scientist with over ten years of experience implementing large tree-based land restoration projects. He is a lead researcher supporting the CGIAR Forest Trees and Agroforestry Programme to increase farmers' access to planting materials, tools and information to improve farming systems' productivity and resilience.

Judith Nzyoka is an assistant scientist in the Landscapes Governance theme of World Agroforestry (ICRAF). She is a water engineer involved in research that explores landscape restoration and conservation, ecosystem-based adaptation, accountability and transparency of natural resource management, greening humanitarian landscapes, payment for ecosystem services and other incentive mechanisms within rural landscapes.

Alagie Bah is an associate researcher at World Agroforestry (ICRAF). He is based in The Gambia and provides technical support to the Large-scale Ecosystem-based Adaptation (EbA) Project. Prior to joining ICRAF, Alagie was a senior lecturer at the School of Agricultural and Environmental Sciences of the University of The Gambia. He holds a PhD from Universiti Putra Malaysia where he specialised in land resource management. His research interests include soil fertility management, climate change and soil ecological health of agroecosystems.

Ramni Jamnadass is a principle scientist leading World Agroforestry's (ICRAF) Global Research on Tree Productivity, Diversity and Delivery. Ramni leads the Flagship on Tree genetic resources to bridge production gaps and promote resilence of the CGIAR Research Programme on Forest Trees and Agroforestry Research Programme – overseeing transdisciplinary teams who work to promote farmer resilience by providing solutions involving tree genetic resources safeguarding, breeding and seed delivery.

Abstract

Every year, millions of dollars are spent on tree-based landscape restoration activities. Over the last five decades, there are few success stories of such interventions and even those do not match the anticipated objectives for which the resources were spent. News articles that announce planting campaigns of millions of seedlings are common. Despite all this, in many countries, vegetation cover has not improved due to poor seedling survival rate. This makes the return on investment low. The objective of this paper is to highlight the main underlying challenges that need to be tackled to make restoration through tree-based interventions successful.

Numerous challenges hamper the success of project-supported public tree growing schemes. 1) Often tree planting is stated as the ultimate objective of the intervention; when that objective should instead be tree growing. Performance indicators are often the number of trees planted or area planted, not the number of trees grown, or the area of land covered with grown trees. 2) Most projects operate on a short time frame (1-3 years) while many tree species (e.g. native trees in many African countries) need more time to sufficiently grow. 3) Emphasis on the right trees, for the right place and the right purposes, is very weak. 4) Even in projects of adequate duration emphasis on after-planting management is often limited. 5) There is lack of tree tenure to formally transfer the management of planted trees to local communities who reside in the landscapes over a long period of time.

Tackling these challenges and changing mindsets is crucial if restoration through tree-based interventions is to yield the intended outcomes of reversing ecosystem degradation.

Keywords: seedling planting, tree growing, planning, indicators, incentives, seedling survival, landscape restoration

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Contents

Acronyms

AFR100	African Forest Landscape Restoration Initiative
CSR	Corporate Social Responsibility
FMNR	Farmer-managed natural regeneration
FTA	CGIAR Research Programme on Forests, Trees and Agroforestry
GCF	Green Climate Fund
ICRAF	World Agroforestry
IPBES	Intergovernmental Panel on Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
ROAM	Restoration Opportunities Assessment Methodology
UNEP	United Nations Environment Programme
USD	United States Dollar

1. Introduction

Our planet earth is losing its vegetation cover at an alarming rate. Latest studies estimated that millions of hectares of forestlands are converted to other land use types every year (Hansen et al. 2013; Bastin et al. 2019; Ordway et al. 2017; Vijay et al. 2016; Curtis et al. 2018). Trees make up the major components of the lost vegetation. Loss of vegetation has led to significant loss of ecosystem functions (Gilmour 2012). According to the report by Scholes et al. (2018), Intergovernmental Panel on Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), degradation of land and marine ecosystems undermines the well-being of 3.2 billion people and costs about 10% of annual global gross domestic product in loss of species and ecosystems services.

Considering the severity of land and marine ecosystem degradation, the United Nations General Assembly declared 2021 – 2030 the UN Decade on ecosystem restoration, with the aim of massively scaling up restoration of degraded and destroyed ecosystems as a proven measure to fight the climate crisis and enhance food security, water supply and biodiversity (UNEP, 2019). The project is ambitious and aims to restore 350 million hectares degraded ecosystems by 2030.

Among the predominant measures put forward to stop this planetary bareness, is growing trees to improve the vegetation cover. Bastin et al. (2019) estimate that the area potentially available to plant and grow trees is about 1.7 -1.8 billion ha to significantly absorb greenhouse gases that currently exacerbate global warming. The ecosystem services provided by individual and groups of trees (forests) are critically needed to reinstate our planet's habitability and functionality on a healthy trajectory. Achieving this goal depends on the success of current restoration initiatives. Minnemeyer et al (2014) estimate that there is close to 1.5 billion ha of degraded land that may be restored through mosaic restoration using tree-based systems (e.g. agroforestry schemes) (Laestadius et al 2015; Wolff et al 2018).

In the past, millions of dollars have been invested in efforts to restore landscapes through planting trees. However, over the last five decades, there were few success stories of such interventions due to the poor field survival rate of planted seedlings (Negussie et al. 2008). In many cases, the failure rate was so high (Cao 2008; Murekezi et al. 2013) that the achieved success from such interventions is lower than the resources invested in it. News articles that announce planting campaigns of millions of seedlings are common, the latest is the 4 billion trees campaign in Ethiopia to regreen the country and restore tree-based ecosystem functions and services. Despite all such efforts at national level, in many countries vegetation cover has not improved proportionally to the investment that is reported. This, however, does not mean that all is lost: Zomer et al. (2016) found out that on-farm tree cover across the tropics has increased. This may have been due to individual efforts rather than big investments in tree growing.

Countries' ambitions to restore landscapes, particularly forests, increased after the creation of global mechanisms like the Bonn Challenge which aim at restoring millions of hectares of forested landscapes to further reduce the extent of forest losses around the planet. These aspiring vision and commitment are now reaching even continental levels (van Oosten 2013) e.g. through the African Forest Landscape Restoration Initiative (AFR100) with the goal of restoring 100 million ha by 2030; in Latin America through the Initiative 20X20 with the vision of restoring 20 million ha by 2020. The largest share of such continental aspirations is meant to be achieved through tree-based restoration schemes.

In sum, restoring ecosystems through tree-based schemes has been going on in many countries with millions of dollars of investments every year. Nonetheless, successes are scanty and untraceable due to poor or no monitoring efforts. Not much has been done to examine why past efforts have not succeeded as anticipated. Hence, ongoing measures to restock tree biomass are taking place as an ad hoc activity rather than a meticulously designed task that needs careful consideration of numerous factors that affect the success rate of the restoration.

The objective of this working paper is to highlight the main underlying challenges that need to be tackled if restoration through tree-based interventions is to be successful. To that end, the paper makes a distinction between tree planting and tree growing to improve the performances of tree-based restoration initiatives. It also highlights how stakeholders can be motivated to adopt more effective concepts of tree growing. The scope of this working paper is limited to tree-based restoration schemes led at national and sub-national levels.

2. The Distinction Between Tree Planting and Tree Growing

Conventional practices of tree-based restoration often are confined to seedling planting, commonly referred to as ‘tree planting’. The main priority in the tree planting schemes is around the acquisition of seedlings and the planting processes. Widespread practice is that the quality of the seedlings is not of much a concern as long as the numbers are met. The designs lack proper articulations of what the interventions intend to achieve. Therefore, the big question is; what happens after the planting?

The ultimate goal of tree planting is to see grown trees that generate ecosystem goods and services that enhance ecosystem functionality and hence fulfilling the needs of the landscape dwellers – both animals and plants. This can only be achieved if tree growing is adopted as the framing of the intervention. The success of a restoration scheme is only ascertained if the planted seedlings grow to trees.

Figure 1 shows a schematic describing the difference between tree planting and tree growing. Tree growing is a process that involves identification of the right planting materials, planting it in the appropriate places and taking care of the planted seedlings so that they can mature to become grown trees (see Figure 1). It involves the pre-planting processes and considerations, the actual planting itself and the after-planting care and management. It is a process that requires at least five years or more even for fast-growing tree species. Such framing of tree growing was lacking in many tree-based restoration interventions, and hence most of the restoration efforts failed to achieve the intended goals. The main emphasis under such schemes was largely on the area of land covered by the activity and/or the number of seedlings planted. Limited attention was given to the pertinent issue of what can increase the survival rate of seedlings, so they become trees.

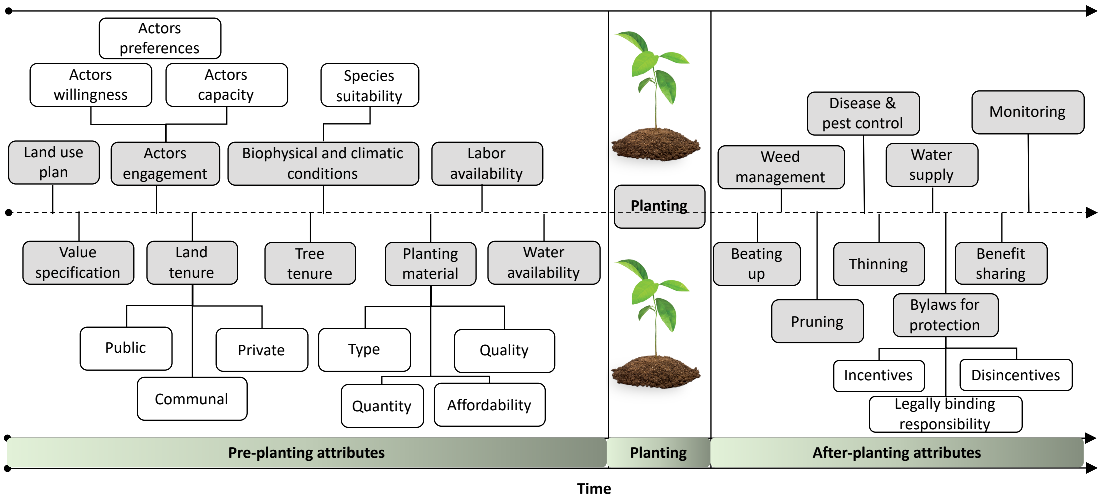

Figure 1 Detailed planning elements for effective tree growing schemes. Shaded boxes denote primary requirements needed to be checked and verified in the process of tree growing.

3. Key Challenges

3.1 The planning cycle is often too short

Most projects operate on a short time frame (1-3 years) while most tree species (particularly the native tree species in Africa) require a longer time of at least 5 years to become trees. It is rare to see restoration projects with a duration of five years or more — the planning cycle especially of projects has shortened significantly over the past 3-4 decades. For planted seedlings to become trees it takes, in many cases, a minimum of 3 years or even longer particularly in areas with growth constraining factors (poor soil conditions, drought, disease, etc.). In dryland areas, drought and rising temperatures with the subsequent fire risks have become dominant factors that limit tree growth. Hence, project duration in such cases need to be more than 3 years. This calls for the re-evaluation of projects, which are to be supported by donor agencies, on how ecosystem restoration projects could be more effective.

The problem associated with the planning cycle is even exacerbated when the projects are supported through government schemes, because government priorities when it comes to environmental issues are changing so frequently, especially in many developing countries. A tree-based restoration intervention that started with tree planting in a given year may be left entirely unfunded the following years depending on how emergent societal and political matters get prioritised. Le et al. (2014) emphasise that the diversification of funding sources is very crucial since most governments do not have the capacity to fully fund reforestation schemes. The authors found that successes of restoration schemes were significantly affected by the types of funding sources.

Whether in the case of donor-supported schemes or government-supported tree-based restoration interventions, it is crucial that sustainable financing solutions for such projects go beyond the planting stage. This can only be achieved if the scope of the restoration intervention is seen as a process beyond tree planting that requires more investment to ensure the planted seedlings also grow to be trees. The next section describes this in further detail.

3.2 The planning scope is very narrow

Numerous key issues of pre-planting and after-planting management need to be considered to make sure the trees grow. In terms of the pre-planting issues, very often there is minimal emphasis on how the planting material is obtained. The quality of the planting material is often questionable for several reasons: 1) Source of seeds: were good quality seeds obtained from the right source? 2) Site matching: do they fit into the context of the planting area in the next few years, especially taking into account climate change or weather variability issues? 3) Phytosanitary matters: are the seeds and seedlings pest and disease-free? In sum, the control over the quality of seeds and seedlings is weak.

Another key pre-planting issue is the preferences of the dwellers of the landscape: do they match the selected species for planting? Such preferences are often guided by the prospective tree products the restoration initiatives could generate. In most parts of Africa, emphasis and preferences are tilted more to fast-growing species, mostly exotic ones due to the shortage of wood owing to population growth. The slow-growing nature of most indigenous African species limits the use of such species for restoration activities.

When it comes to after-planting issues, proper arrangements for resources and capacity must be in place. If the value generation agenda is adequately articulated and embedded in the restoration planning, proper benefit sharing principles must be in place so that the benefits accruing from the restoration scheme reach the community.

Besides the issues described above, to-date most tree-based restoration interventions have lacked a bottom-up consultative process of engaging communities in the interventions. Hence, communities often find themselves at odds trying to figure out how the interventions will benefit them or even what incentives they have to engage in them. In addition, it happens that, when the responsible actors in charge of a restoration project (who often are from outside the community) are around, the locals do not usually have clear roles and responsibilities.

Most importantly, the mindset of viewing restoration as tree planting rather than the process of tree growing affects people's views of the scope of the intervention. Our view guides the way we plan for the intervention. Therefore, to-date, mere tree planting is so prevalent despite being a single event rather than being seen as one of the many key actions to achieve restoration targets. This short-sighted mindset needs to change to make tree-based restoration successful.

3.3 Tree growing can also happen "without" planting

To grow trees, one may not necessarily rely only on planting seedlings. Shoo and Catterall (2013) explored other alternative strategies to restore landscapes other than planting. It is possible to grow trees through natural regeneration mechanisms in which protection against external factors that hamper growth may play a crucial role. For instance, in the case of assisted natural regeneration, investments should largely focus on reducing or removing the barriers for naturally grown seedlings to develop and on facilitating the germination of seeds in a soil seed bank. It is even assumed that such schemes may lead to more resilient saplings than those seedlings raised in tree nurseries (FAO 2019; Chazdon and Guariguata 2016).

In degraded agricultural landscapes, communities are now widely adopting farmer-managed natural regeneration (FMNR) as a means of achieving restoration targets. There are successful cases of FMNR in Niger (Haglund et al. 2011; Larwanou and Saadou 2011; Reij and Garrity 2016; Binam et al. 2015); in Ethiopia (Hadgu et al. 2009; Brown et al. 2011; Francis et al. 2015); in Shinyanga, Tanzania (Duguma et al. 2014; Nzyoka et al. 2018) and others.

Other emerging technologies such as the use of seedballs for rehabilitating large areas of degraded lands is gaining traction. Seedballs (Seedballs Kenya 2018) are balls with seeds and fertile startup feed composed of biochar and growth nutrients. The seeds in the balls germinate when moisture becomes available (usually through rain) and commence the process of establishing themselves. The seeds packaged as seedballs are protected against consumption by rodents and birds and hence are expected to ensure a high rate of germination success. Nonetheless, the after-germination care for such seedlings is still crucial to ensure they grow to become trees that provide the anticipated ecosystem services and functions.

Vegetative propagation could also be used as one of the key means to restock degraded landscapes. The effectiveness of the scheme relies on the fact that it uses stocks and scions that are resilient enough to establish themselves once the growing environment is suitable. Vegetative propagation could also be used to improve the quality of products from trees that are grown as part of the restoration scheme and ultimately improving products quality from restoration initiatives.

3.4 The ‘what is done’ versus ‘what the communities want’ gap is wide

Communities all across Africa and other continents see the importance of growing trees. There is hardly any place where growing trees is rejected as the solution to the declining forest cover and increasing shortage of wood supply both at industrial scale and household level. Walker (2004) examined the situation in Malawi where despite the shortage of wood products farmers are not enthusiastic about planting trees. The author found that the narrative used to convince farmers to grow trees did not match their interests (e.g. fruits trees, forage species, timber species, etc.) and hence made them reluctant to do what was proposed by government officials who recommend tree planting as a solution to the problem.

For restoration to be effective, proper governance mechanisms that represent the needs of the dwellers of the landscape should be appropriately captured. If this is not possible, restoration cannot be successful because the local communities who are expected to take responsibility for the long-term management of the intervention will not be invested in the activity. Most restoration efforts fail to create values that the local communities perceive as necessary to own the intervention. Addressing this gap requires a proper stakeholder engagement process wherein the needs and interests of the local communities are captured so that the interventions reflect their needs at least to some degree if not wholly. Value creation thus needs to be at the core of the planning in tree-based restoration efforts. Taking in to account the communities’ values in the planning process and framing them as challenges, which the tree-based interventions could help them meet, may act as a strong incentive for the local communities to take care of the landscape restoration.

If the points discussed above are not considered, restoration just remains a commitment only, rather than addressing the needs of the local communities who are left with the interventions and management of the same after that. A handful of the tree planting interventions in the past failed (e.g. see Cao 2008; Le et al. 2014) because of the short-sighted planning models and because they focussed their reporting on the land area or the number of trees planted instead of considering the survival of the trees to ensure ecosystem restoration at a larger scale. This also meant looking at how the planted trees would be taken care of. Such failures were driven by the strong ambition of the countries or the project implementors to report on the figures they had committed to or on the indicators specified as measures of performance. Overall, project implementors, especially from outside the communities in the landscape, should not put their commitments above the needs of the communities, but should consider those needs already in the planning process to avoid a disconnect between the 'what we want' and 'what the communities want'.

3.5 Tree planting alone should not be given a credit as a fight for environmentalism

Tree planting campaigns are used as marks of environmentalism by various actors (e.g. NGOs, governments, and other entities). Corporate social responsibility schemes by private sector entities have focussed on identifying open places and then planting seedlings. Though such activities happen in close collaboration with government entities, current practices reveal that such approaches often lack sustained engagement wherein the actors should have consistently cared for the planted seedlings to ensure their growth. Instead, they do not have any plans beyond planting and do not invest in after-planting care. Though some companies assume that the government will take care of the planted seedlings, the actual practices show that governments have too many engagements to do so. Hence, tree planting can be a sort of 'greenwashing' where companies do things for the sake of fulfilling obligations but not taking responsibilities for making it work to achieve the ultimate goal.

Tree seedlings are not throwaway organisms that can grow anywhere. They need proper soil to grow on, watering during the dry season, pest and disease control, protection against fire and against livestock damage. Wassie et al. (2009) show that fenced plots had a higher survival rate of seedlings compared to non-fenced ones as they were less trampled on by animals. Reubens et al. (2009) also emphasise the need for better shelter management to make planted trees survive.

Most importantly, the climate in which trees grow should also be suitable, i.e. all species must be matched to the proper sites (van Breugel et al 2011). Thus, considering the recent changes in climatic variables critical for plant growth such as rainfall and temperature, it is crucial to do proper assessments of whether the changed conditions are still suitable for the growth of the seedlings to be planted. Numerous studies reported that species like coffee and fruits may change their growing ranges under the influence of ongoing long-term climate change and short-term climate variability (Ovalle-Rivera et al 2015).

3.6 Understanding of what it takes to grow trees is important

Many restoration projects fail to deliver on their goals as restoration is regularly considered costly and usually takes many years to deliver desired outcomes. Factors, such as how much funding is available, influence the decisions of where and when restoration will be implemented. As a consequence, restoration decisions are likely to be made in an off-the-cuff manner. Also, when planning restoration projects, actors often do not consider how likely they will succeed and how their actions will ultimately affect costs and decision-making. This might compromise the achievement of the restoration objectives within a project lifecycle (Wilson et al. 2011).

In The Gambia, together with field practitioners and officials, we had analysed data of the costs of establishing a hectare of grown tree stand using 11 common species. Since this working paper distinguishes between tree planting and tree growing, we aggregated and averaged out the numbers to get an approximate estimate (see Table 1). The cost estimates do not even include other expenses that are crucial to run the implementing departments such as salaries (employees of institutions implementing the activities) or office costs, among others. Hence, the costs indicated are only those directly related to field activities. Also, we used 8 years duration as the average time span it takes to establish trees to overcome growth limiting factors such as water shortage, fire hazards and free-roaming livestock, which are important to consider in the context of The Gambia. The estimates for The Gambia may be higher than elsewhere due to the numerous inputs and or management interventions required for the trees under the dry agroclimatic conditions and land management practices where animals roam freely.

Table 1 Estimates of costs (USD/ha) for establishing tree stands in The Gambia

Tree species	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Total cost Year 0-7**
Adansonia digitata (Baobab)	2,418.37	1,040.82	989.80	755.10	685.71	693.88	724.49	808.16	8,116.33
Anacardium occidentale (Cashew)	4,255.10	1,330.61	1,257.14	857.14	806.12	653.06	734.69	859.18	10,753.06
Bombax costatum (Bunkungo)	3,642.86	1,204.08	1,071.43	734.69	685.71	673.47	714.29	777.55	9,504.08
Citrus aurantiifolia (Lime)	2,969.39	989.80	959.18	724.49	653.06	612.24	653.06	675.51	8,236.73
Citrus sinensis (Orange)	4,663.27	1,387.76	1,214.29	806.12	818.37	695.92	755.10	869.39	11,210.20
Cocos nucifera (Coconut)	4,316.33	1,122.45	938.78	775.51	726.53	734.69	765.31	808.16	10,187.76

Cordyla africana (wild Mango)	3,683.67	1,204.08	1,051.02	734.69	673.47	673.47	724.49	767.35	9,512.24
Khaya senegalensis (Mahogany)	3,989.80	1,071.43	1,071.43	765.31	744.90	683.67	755.10	869.39	9,951.02
Mangifera indica (Mango)	2,846.94	1,157.14	1,104.08	836.73	744.90	663.27	724.49	836.73	8,914.29
Moringa oleifera (Moringa)	3,357.14	979.59	948.98	734.69	673.47	653.06	693.88	734.69	8,775.51
Pterocarpus erinacius (African Rosewood)	3,908.16	1,183.67	1,040.82	755.10	685.71	693.88	724.49	767.35	9,759.18
Mean annual investment (USD)	**3,641.00**	**1,151.95**	**1,058.81**	**770.87**	**718.00**	**675.51**	**724.49**	**797.59**	**9,538.22**
Share (%) of average investment for tree growing	**38%**	**12%**	**11%**	**8%**	**8%**	**7%**	**8%**	**8%**	**-**

Source: Own field data

The costs of the first two years (year 0 and 1) comprise half of the total cost of tree growing (Table 1) due to the high initial investments required for the planting material acquisition and site preparation (see Figure 2). It is rare to find plans for tree growing that have clear budgets and work plans to maintain the trees until they grow well. The main limitation in the continuous campaign mode of tree plantings are the lack of clear plans and resources after year 0 and most probably year 1. The years 2-7 are critical for the planted seedlings to survive and qualify as trees that can be counted as achievements. Figure 2 indicates the high costs of watering the plants and protecting the planted trees from fire and livestock. This mainly relates to the low rainfall and the dominant pastoral livelihood activities in the country (Figure 2).

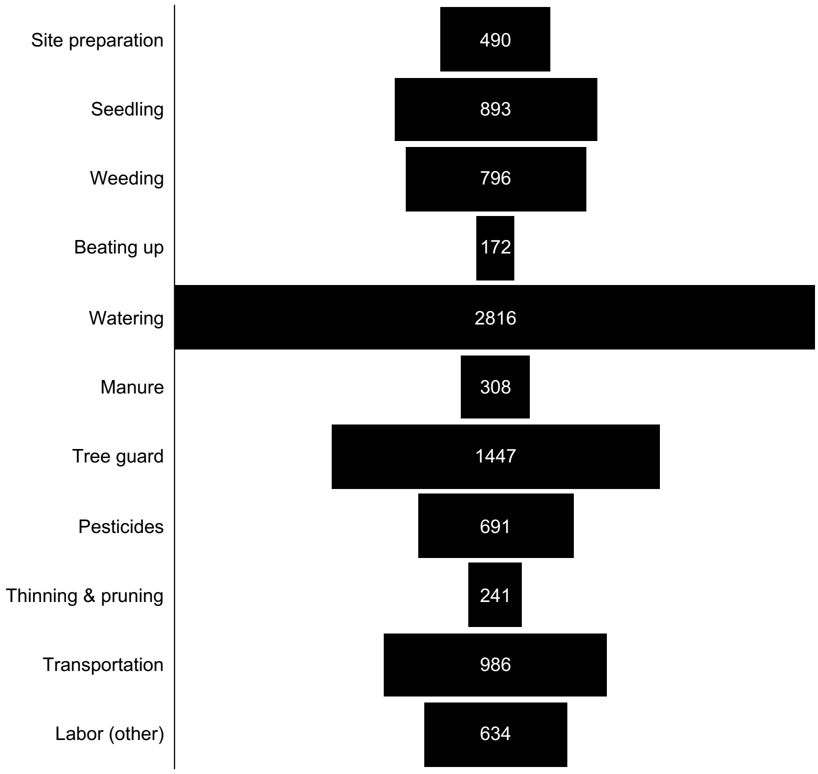

Figure 2: Estimate of costs of establishing a one-hectare stand of woodlot in The Gambia over a period of eight years (Source: own field data)

Using this experience from The Gambia as an example, those engaging in restoration initiatives must assign commensurate resources (i.e. financially and technically) to ensure that the investments made in the first one or two years are not in vain. Government agencies responsible for restoration should also oblige the actors interested in restoration to put aside the resources required for proper care of the planted seedlings in the years ahead.

4. Actions for effective tree growing

Numerous actions can be taken to make current tree planting campaigns successful so that they produce grown trees and thus make restoration effective.

4.1 Disaggregate process indicators from performance indicators to monitor restoration progress

For entities involved in tree-based restoration interventions, it is necessary to frame their contributions as process indicator, i.e. planting is the starting process towards tree growing. Their contribution in the process of restocking the ecosystem should be rightly acknowledged, but stakeholders must know that they started the scheme and the journey has to continue to achieve the ultimate objective which is to restore ecosystems that provide multiple benefits. If the entities lack the capacity to continue, national and subnational institutions should take responsibility to allocate the appropriate resources to make the trees grow.

The performance indicator should emphasise what kind of landscape is intended to be achieved at the end of the tree-based restoration investment. The ultimate goal behind a restoration scheme is not only putting trees into the landscape, but also improving the state of delivery of ecosystem services and functions. Hence, we argue that it is not possible to have a landscape with sufficient trees within one or two years. What determines the success of the restoration scheme is delivery of the anticipated goods and services. That is why the end goal of the investment should be clearly defined by identifying the kind of landscape that is envisaged. The roadmap to getting to the envisaged landscape then should be retro-planned.

Overall, today's restoration investments are usually based on a thought system that disregards the complexity and uncertainty associated with tree growth especially under conditions such as climate change and human needs change (e.g. expanding urbanization, migration, etc.). On the contrary, backcasting, i.e. planning from the ultimate objective backwards to the current context (Robinson et al. 2011), seems to be a convincing logic. Stanturf et al. (2014) state that the lack of defined expectations from the restoration initiatives is among the key causes of failures (Dey and Schweitzer 2014). The definition of the expectations and the end points (goals) of restoration needs to take into account biophysical expectations, societal needs and anticipated future environmental conditions (Dey and Schweitzer 2014).

Current tree planting, in general, lacks the definition of what the target is (except anticipating there will be more trees in the landscape) and what it takes along the way to get the planted trees to form the expected ecosystem structure that delivers both ecological and societal functions. Hence, it is difficult to monitor signs of progress except for survival rates.

4.2 Developing an accountability framework is crucial

A restoration initiative will only have achieved its target when the trees have grown and begun generating ecosystem services and functions. To address the lack of sustained engagement in many developing countries, it is necessary to design a proper institutional accountability scheme that ensures there is at least one entity tasked with caring for the planted seedlings. A sample financial accountability scheme is indicated below for various investment support models for tree growing (Table 2). Le et al. (2014), using the case of restoration in the Philippines, advocate for diversified funding mechanisms that ensure continued care for the planted trees. The diversification makes sure that sufficient resources for the needed care and technical support for the interventions are provided. Technical accountability should also be developed side by side with financial accountability because different institutions do have different roles in making the restoration targets achievable.

Table 2 Potential accountability framework to guide tree growing schemes by various actors

	Source of funds	**Responsibility by tree growing years**								**Description**
		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
1	Donor	Donor								Donor 100%
2	Donor	Donor			National governments, sub-national sector/counties, local communities					Donor Y0-2, National governments, sub-national sector/counties, local communities Y3-7
3	National governments	National governments								National governments 100%
4	National governments, subnational level	National governments			Sub-national sector/counties, local communities					National governments Y0-2, sub-national sector/counties, local communities Y3-7
5	Local authorities/ communities, sub-national sectors/counties	Local authorities and sub-national sectors/counties, local communities								Local authorities, sub-national sector/counties 100%
6	Philanthropists	Philanthropists			National governmental/ sub national					Philanthropists Y0-3, national governments/ sub national Y5-7
7	Corporate Social Responsibility (CSR)	CSR			National governmental/ local counties					CSR Y0-2, National government/ local authorities

Note: This proposition should only be used as an illustration rather than a rule of the thumb, as contexts vary widely. Y stands for year.

4.3 Protocols for sustained engagement should be in place

It is necessary that there is a clear protocol which obliges every party engaged in tree planting to provide planned interventions to ensure that the planted trees grow. This is the critical missing link in public tree planting schemes. There is a dire need to make sure resource allocations for restoration projects are not only for the initial establishment phase. It is important to note that it is impossible to achieve restoration with projects of less than 3 years duration.

4.4 Effective use of resources is crucial to achieving the ultimate objectives of restoration activities.

Most of the initial key actors of restoration projects often do not stay in the landscape for longer periods. After the planting, the intervention areas are left to the local government authorities or relevant government agencies, particularly to departments or units dealing with forestry, environment, or natural resources. Such local institutions often lack the necessary resources to run their operations and with time gradually abandon the intervention sites. It is, therefore, crucial to allocate the commensurate amount of resources that can make restoration investments effective. By following the accountability framework proposed above (see Table 2), the government could make resource allocations realistic. Without such resource allocations and necessary technical support schemes it is less likely that the planted seedling will grow to become a tree.

Restoration activities should effectively target areas which need restoring, and, to use limited available resources effectively, there should be a clear procedure of prioritisation of where interventions are most needed. Often, there is a tendency to rather target areas with a high likelihood of success than areas which are severely degraded and need to be restored. It can also happen that resources are directed to areas where the need for restoration is low. Bond et al. (2019) indicate that the planned restoration of 1 million square km of land in Africa, almost the same size as the land area of Ethiopia, is focussed on grasslands where, ecologically, the need for restoration is low. Cases of misinterpretation of what degraded lands are could also limit the effectiveness of restoration investments. Kumar et al. (2019), for instance, caution that wrongly classifying Asian savannahs as degraded forest could lead to improper management of these ecosystems with subsequent tradeoffs. A similar misconception has been reported in Oregon, USA. According to Vogler et al. (2015), projects observed in Oregon seemed to match modelled high-priority national planning areas for restoration. However, study results indicate that the selected sites were indeed low priority for restoration. In some cases, though, it is acknowledged that current restoration efforts target high-stress sites exclusively, but generally without knowledge of the full range of stressors affecting the capacity of different locations within a particular landscape to provide ecosystem services (Allan et al. 2013).

Duguma and Minang (2014) emphasise the need for a proper understanding of the causes of degradation so that restoration investments achieve the intended goals. Numerous factors let ecosystems degrade – such as overexploitation, climate factors, soil properties change, pollution, pests, and diseases. There is also a need to involve local communities and actors in decision-making on areas where restoration is needed. This helps to prioritise interventions, making them more effective. In this regard, tools such as ROAM (Restoration Opportunities Assessment Methodology) (IUCN and World Resources Institute, 2014) could help select areas for restoration in consultation with local actors.

4.5 The right tree species for the right place and the right purpose are needed

A major challenge in tree-based restoration is the need to work with many tree species at the same time. Planting for landscape replenishment or enrichment requires the supply of genetically diverse, healthy, and productive tree species matched to planting sites. Often diverse planting materials are not available, and many land restorationists end up using whatever material that is locally available. This practice is fraught with mismatch of planting site and tree and with the potential risk of using invasive species. Frequently such trees fail to grow adequately, and the investment is lost. For instance, Ahrends et al. (2017) indicate, that despite China's investment of over USD 100 billion in a decade, the reported gains in vegetation cover were much lower due to the plantings happening in areas identified as less suitable for tree growing. To address such shortcoming, World Agroforestry (ICRAF) has developed tools such as Agroforestree database (Orwa et al. 2009) and vegetation maps (Kindt et al. 2011; van Breugel et al. 2011) that provide knowledge on species-specific characteristics for most tree species for areas that are considered for restoration.

5. Some recommendations to make tree-based restoration investments work

For investments in tree-based interventions to lead to anticipated results (i.e. restored green vegetation areas providing the ecosystem functions and services) the following general measures are recommended:

- Donors, government agencies and any other stakeholders engaged in tree-based interventions should realise that seedling planting is a one-time event and tree growing is a process that also involves the management of planted trees. Hence, projects or interventions focusing on one-season activity of tree planting should not be promoted as they will result in a waste of resources.

- Strategies to strengthen the ownership of restoration efforts by local actors and communities should be promoted. Tree growing schemes should focus on the generation of value (income, consumption, ecosystem goods and services) that has priority for the dwellers of the landscape. This will help communities to take over the management of the planted seedlings even when the projects are short-term. Incentives for local communities to take up the management during and after planting should also be crafted.
- If there is limited local capacity, funders should ensure there is a clear justification and strategy by the implementors to continue managing the planted seedlings and take care of them afterwards. Unless such strategies are in place, governments and donors should not approve any one-season tree planting activity.
- Finally, the basis for tree-based restoration discourse should be tree growing, not tree planting.

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United Nations Avenue, Gigiri • PO Box 30677 • Nairobi, 00100 • Kenya
Telephone: +254 20 7224000 or via USA +1 650 833 6645
Fax: +254 20 7224001 or via USA +1 650 833 6646
Email: worldagroforestry@cgiar.org • www.worldagroforestry.org