



Preventing Forest Loss, Promoting Restoration, and Integrating Sustainability into Ethiopia's Coffee Value Chains and Food Systems (FOLUR Ethiopia Project)

TREE PLANTING GUIDELINE

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Preface

Ethiopia's forests and tree-based agricultural landscapes provide essential environmental, economic, and social benefits to millions of people. However, ongoing deforestation, land degradation, and unsustainable land-use practices continue to undermine the health and productivity of these ecosystems. Addressing these challenges requires practical restoration approaches that ensure trees are not only planted but successfully established and managed.

The FOLUR Ethiopia Project—Preventing Forest Loss, Promoting Restoration, and Integrating Sustainability into Ethiopia's Coffee Value Chains and Food Systems—supports landscape restoration and sustainable land management across Oromia, Sidama, South Ethiopia, and Southwest Ethiopia Regions. As part of these efforts, tree planting and agroforestry interventions play a critical role in restoring degraded lands, enhancing biodiversity, strengthening climate resilience, and improving rural livelihoods.

This Tree Planting Guideline has been developed to provide practical guidance for extension workers, nursery operators, community organizations, development practitioners, local government experts, and farmers engaged in restoration activities. Drawing on national experience and internationally recognized good practices, the manual outlines key steps for successful tree establishment, including species selection, nursery management, site preparation, planting techniques, post-planting care, and monitoring.

The guideline promotes the use of indigenous and multipurpose tree species, climate-smart restoration practices, gender-responsive implementation, and community participation. It is aligned with the objectives of the FOLUR Ethiopia Project, Ethiopia's Green Legacy Initiative, and local Integrated Land Use Plans (ILUPs).

The FOLUR Ethiopia Project Management Unit (PMU) believes that this manual will serve as a practical field reference that contributes to improved seedling survival, healthier landscapes, enhanced livelihoods, and sustainable restoration outcomes across Ethiopia's diverse ecosystems.

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1. Introduction

Ethiopia is home to some of Africa's most biodiverse Afromontane forests, diverse savanna woodlands, and tree-based agroforestry systems. These forest ecosystems provide essential environmental and economic services: they regulate water cycles, protect soils from erosion, sequester carbon, harbour exceptional biodiversity including the wild relatives of Arabica coffee, and sustain the livelihoods of millions of rural households through timber, fuelwood, non-timber forest products, and shade-grown agriculture.

Despite their immense value, Ethiopia's forests and tree-covered lands have faced decades of deforestation and land degradation driven by agricultural expansion, fuelwood demand, overgrazing, and unsustainable land use practices. These pressures have significantly reduced forest cover, degraded watershed functions, diminished biodiversity, and increased the vulnerability of farming communities to climate variability.

Restoring trees to degraded landscapes is one of the most cost-effective pathways to reversing these trends. Well-planned tree planting rehabilitates degraded soils, recharges water tables, sequesters carbon, recreates wildlife habitats, and rebuilds the productive capacity of agroforestry systems (UNEP & FAO, 2020). A single mature tree can absorb over 22 kg of CO₂ annually while releasing oxygen essential for human survival (USDA, 2015).

Ethiopia's national restoration commitment—anchored in the Green Legacy Initiative (GLI), which has mobilized the planting of billions of trees since 2019; this reflects the country's determination to reverse forest loss and restore degraded landscapes at scale. The FOLUR Ethiopia Project (Preventing Forest Loss, Promoting Restoration, and Integrating Sustainability into Ethiopia's Coffee Value Chains and Food Systems) directly supports these national ambitions through an integrated approach linking forest restoration, sustainable coffee farming, food system resilience, and women's economic empowerment.

Improper planting procedure is one of the main reasons for the death of seedlings in the field after planting. This leads to wastage of planting materials and lost sources of income and ecosystem services. If proper handling, planting, and maintenance procedures are followed, seedlings will have improved chances of survival.

What is this manual about?

This manual outline information necessary to successfully:

- prepare a field for outplanting;
- identify which planting material is ready for outplanting;
- handle and transport seedlings from the nursery to the planting site;
- avoid common mistakes in outplanting; and
- care for the seedlings at the planting site.

This manual provides field-level guidance for tree plantation activities under the FOLUR Ethiopia Project across 22 woredas in the four project regions: Oromia, Sidama, South Ethiopia, and Southwest Ethiopia.

2. Species Selection

2.1 Prioritize Native Afromontane Species

FOLUR Ethiopia's restoration mandate prioritizes the use of indigenous, locally adapted tree species. Ethiopia's Afromontane forests form a core component of the Eastern Afromontane Biodiversity Hotspot, one of the world's most biologically rich regions, supporting a high concentration of endemic plant and animal species (Conservation International, 2012; Friis et al., 2010). The use of native species in restoration helps maintain ecological integrity, supports biodiversity conservation, and enhances ecosystem resilience, whereas inappropriate introduction of exotic species may alter ecosystem processes and compromise long-term restoration outcomes (Brancalion & Holl, 2020; FAO & UNEP, 2020).

Prioritize species with demonstrated natural regeneration in the target landscape. Community nursery staff and local forest user groups are valuable sources of knowledge about species distribution and regeneration history.

Recommended Native Species by Landscape Type

Landscape / Purpose	Recommended Native Species
Moist Afromontane Forest restoration	<i>Cordia africana</i> , <i>Pouteria adolfi-friederici</i> , <i>Albizia grandibracteata</i> , <i>Albizia schimperiana</i> , <i>Bersama abyssinica</i> , <i>Croton macrostachyus</i>
Dry Afromontane restoration	<i>Juniperus procera</i> , <i>Olea europaea subsp. cuspidata</i> , <i>Podocarpus falcatus</i>
Coffee agroforestry shade canopy	<i>Millettia ferruginea</i> , <i>Albizia spp.</i> , <i>Erythrina brucei</i> , <i>Cordia Africana</i>
Riparian and watershed protection	<i>Syzygium guineense</i> , <i>Ficus spp.</i> , <i>Diospyros abyssinica</i>
Boundary planting and multipurpose	<i>Croton macrostachyus</i> , <i>Dracaena afromontana</i> , <i>Pavetta abyssinica</i>

Source: Adapted from Friis et al. (2010), EFAP (1994), and ICRAF Agroforestry Species Database.

FOLUR Alignment Note

- Species selection must be consistent with the project's Integrated Land Use Plans (ILUPs) developed for each woreda.
- Shade-grown coffee agroforestry systems can support a high proportion of native woody species; therefore, priority should be given to diversified multi-strata systems rather than monocultures.
- Avoid exotic fast-growing species (e.g. Eucalyptus, Cupressus) in forest restoration plots; these are permitted only in designated fuelwood or woodlot areas away from natural forest.

2.2 Align Species Selection with Site Conditions

FOLUR Ethiopia project implementing landscapes span elevations from roughly 1,200 m to over 3,000 m above sea level, with significant variation in rainfall, soil type, and temperature. Conduct a rapid site assessment before finalizing species lists for each planting area.

Site Factors and Species Matching Considerations (FOLUR Ethiopia—Multi-Regional Context)

Site Factor	Considerations for Species Matching
Elevation	Elevation is a primary driver of ecological zonation across Ethiopia and strongly influences species distribution. Moist Afrotropical species (e.g., <i>Cordia africana</i> , <i>Albizia</i> spp., <i>Croton macrostachyus</i>) are commonly associated with mid-elevation humid to sub-humid zones, while dry Afrotropical species (e.g., <i>Juniperus procera</i> , <i>Olea europaea</i> subsp. <i>cuspidata</i> , <i>Acacia abyssinica</i>) are more characteristic of higher elevation and relatively drier highland ecosystems. Species selection should follow local ecological conditions and vegetation zone transitions. (Friis et al., 2010; Friis et al., 2011)
Rainfall	Rainfall regimes in Ethiopia range from humid highland to semi-arid lowlands, strongly affecting species suitability. In wetter zones, shade-tolerant and moisture-demanding native species are appropriate, while drought-tolerant, deep-rooted species are better suited to drier environments. Seasonal rainfall distribution and moisture availability should guide species-site matching rather than annual averages alone. (FAO, 2015; Friis et al., 2010)
Soil type	Ethiopia's major soil types include Vertisols, Nitisols, Cambisols, and Leptosols, each with distinct constraints and opportunities. Vertisols often present drainage limitations and seasonal waterlogging, while Nitisols are generally deep, well-drained, and favorable for agroforestry and coffee systems. Species selection should consider soil drainage, rooting depth, and sensitivity to acidity and compaction. (IUSS WRB, 2015/2022; FAO, 2015)
Land use history	Land use history strongly determines restoration pathways and assemblages. Degraded coffee systems may still retain forest species and support assisted natural regeneration, while severely degraded or open lands require active restoration using pioneer and framework species. Riparian and watershed areas require native, moisture-adapted species to stabilize soils and regulate hydrology. (Friis et al., 2010; FAO, 2013)
Community livelihood needs	Restoration designs should integrate livelihood priorities by selecting multipurpose native and locally adapted species that provide timber, fuelwood, fodder, fruits, shade (especially in coffee systems), and non-timber forest products (NTFPs). This approach supports adoption of restoration interventions and aligns with Integrated Land Use Planning (ILUP) and landscape restoration objectives under FOLUR. (FAO, 2013; World Bank, 2021)

3. Nursery Management and Sapling Quality

3.1 Community Nursery Standards

FOLUR Ethiopia supports community-managed nurseries as a primary source of planting material. Nurseries should be sited near water sources, with partial shade and good soil access.

Standard Area	Requirements and Best Practice Guidelines
Nursery siting and setup	Community nurseries should be established in accessible locations with reliable water supply, partial shade, gentle slope, and well-drained fertile soil. Proper site selection improves seedling vigor, reduces stress, and supports efficient production for landscape restoration programs.
Seedling age and transplant readiness	Most native Afromontane tree species are generally ready for outplanting at 8–12 months under good nursery management. Slow-growing species such as <i>Juniperus procera</i> and <i>Olea europaea</i> subsp. <i>cuspidata</i> may require 12–24 months to reach field-ready size due to inherently slow growth characteristics.
Root system quality	Seedlings should have a well-developed, fibrous root system with a compact but non-deformed root ball. Active white root tips should be visible. Root deformation such as spiraling or pot binding must be avoided as it reduces survival and long-term field performance.
Shoot and stem quality	Seedlings must have a straight, well-lignified stem with balanced shoot and root growth. Foliage should be healthy green, without chlorosis, necrosis, or wilting, indicating proper nutrition and hardening conditions.
Pest and disease management	Foliage should be healthy green, without chlorosis, necrosis, or wilting, indicating proper nutrition and hardening conditions. Planting material must be free from visible pests and disease symptoms. Common nursery issues include leaf miners, aphids, scale insects, damping-off, and fungal leaf spots, particularly under humid conditions. Regular inspection and sanitation are required.
Provenance and genetic suitability	Seedlings should be raised from locally collected or ecologically matched seed sources to ensure adaptation to local environmental conditions. Preference should be given to native seed sources from the same or similar agroecological zones to maintain genetic integrity and improve survival rates.

Sources: Adapted and synthesized from FAO (2012;14;15); WWF & IUCN (2021)

Gender & Inclusion Note

- FOLUR Ethiopia targets 50% female beneficiaries. Prioritize women-led community nursery groups for sapling production contracts.
- Nursery management training should be delivered in local languages with gender disaggregated tracking of participants and earnings.

3.2 Hardening and Pre-Planting Preparation

Seedlings raised in sheltered nursery conditions must be gradually hardened before field planting:

- Reduce shade cover progressively over 2–4 weeks before transplanting
- Reduce watering frequency (not volume) to simulate field soil moisture conditions
- Transport in the cool of morning or evening; protect roots from sun and wind exposure during transport
- Inspect root balls on arrival at the planting site and reject any with cracked, dry, or contaminated substrate

4. Optimal Planting Time

4.1 Seasonal Calendar for FOLUR Ethiopia Regions

The Afromontane highlands of the FOLUR project regions experience two distinct rainy seasons in most areas. Planting timing must account for local rainfall patterns, which vary significantly between the southwest (long single rainy season) and other regions.

Planting Window	Conditions and Guidance
Main season: mid-June – mid-September (Kiremt / main rains)	Optimal for most species. Soil moisture is high, temperatures moderate. Target the first 4–6 weeks of rain for best establishment. Avoid planting during peak rainfall intensity to reduce waterlogging risk.
Short season: March – April (Belg rains, where applicable)	Suitable in bi-modal rainfall areas (parts of Oromia). Use for fast-establishing multipurpose trees; less suitable for slow-growing forest species.
Dry season planting (with irrigation)	Only where reliable water sources are available (springs, streams). Requires supplemental watering at minimum weekly intervals. Not recommended for large-scale restoration plots.
Avoid: December – February	Dry season with high evapotranspiration and soil moisture stress. Survival rates significantly reduced for most native species.

Ethiopia's Green Legacy Initiative mobilizes millions of community planters each year during June–September. FOLUR restoration activities should coordinate with GLI schedules to benefit from community mobilization while ensuring seedlings meet the quality standards in Section 2.

5. Planting Techniques

5.1 Site Preparation

- Clear invasive vegetation (*Lantana camara*, *Parthenium hysterophorus*, and other exotic invasives common in degraded sites) before planting.

- Avoid complete burning of vegetation cover: use manual clearing or slash-and-mulch to preserve soil organic matter and soil biota
- On steep slopes (>30%), implement physical soil and water conservation structures (bunds, trenches) before planting to reduce erosion risk
- Mark planting positions and dig pits 2–3 weeks before the planting date to allow pit walls to weather

5.2 Methods of site preparation

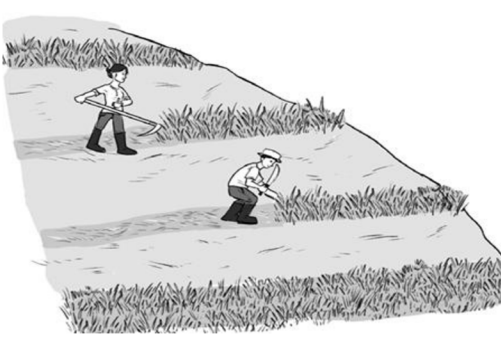
The two methods of site preparation are 1) complete removal and 2) partial removal.

a. Complete removal:

This involves cutting all the grass and weeds growing at the planting site.

b. Partial removal:

This involves brushing the grasses, weeds, and other vegetation growing in specific areas within the planting site.

Strip clearing This is the practice of cutting grass and other vegetation in strips around 1 to 2 m wide. In areas with steeper slopes, follow the contours using either an A-frame (refer to page 8) and remove all vegetation.	 The illustration shows two people on a sloped terrain. One person is standing and holding a long-handled tool, possibly a machete or a brush, while the other is crouching and working on the ground. They are clearing a strip of vegetation along the contour of the slope.
Spot/patch clearing This means clearing the vegetation in spots or patches of 1 to 2 m diameter where seedlings are to be planted. Loosen the soil in the cleared areas and remove rocks and stones that can impede the growth of the seedlings.	 The illustration shows a person crouching in a circular patch of cleared ground, surrounded by tall grass. The person is using a machete to clear the vegetation within the patch.

Source: Adapted from Mercado (2019)

Key Considerations for Vegetation Clearing on Restoration Sites

Vegetation clearing on restoration sites must be done selectively; balancing the need to reduce competition for newly planted seedlings with the imperative to protect soils, water, and biodiversity under Ethiopia's environmental and forestry legal frameworks.

■ **Clear selectively, not completely:** Remove only competing shrubs and grasses that suppress seedling growth. Full clearing is rarely justified and risks accelerating the land degradation that FOLUR seeks to reverse.

■ **Retain natural regeneration:** Preserve self-regenerated indigenous trees and useful shrubs in enrichment planting areas. In Ethiopia's coffee forest margins and montane zones, existing trees can serve as nurse trees for shade-tolerant species such as coffee (*Coffea arabica*) and indigenous multipurpose species.

■ **Protect riparian buffers:** Do not clear vegetation along rivers, streams, springs, or wetlands. Ethiopia's highland watersheds; critical for downstream communities depend on intact riparian cover.

■ **Use strip or spot clearing on low vegetation:** Where existing vegetation is below 1 meter, use strip or spot clearing and slash residues as mulch. This is especially important on the steep slopes of Ethiopia's highlands, where bare soils are highly susceptible to erosion during heavy seasonal rains.

■ **Prioritize indigenous multipurpose species:** Enrichment planting should favour locally adapted indigenous species that serve multiple functions — soil improvement, shade, fodder, fuelwood, and income. Examples include *Cordia africana*, *Millettia ferruginea* (Birbira), *Croton macrostachyus* (Bisana), *Hagenia abyssinica*, and *Acacia* species suited to drier agroforestry zones.

5.3 Spacing Guidelines

Spacing must balance the ecological goals of forest restoration against practical land use realities in smallholder farming landscapes. (*ICRAF Agroforestry Design Manual, 2020*).

Tree spacing depends on: species characteristics and crown size; site conditions (soil fertility, rainfall, slope); restoration objectives; compatibility with crops and livestock; and management intensity.

In agroforestry systems, wider spacing is generally preferred to allow sufficient sunlight penetration for crops. In forest landscape restoration and enrichment planting, spacing may be closer to accelerate canopy recovery and ecological restoration.

As a general guideline:

- Broad-canopy species require wider spacing.
- Fast-growing species require more space.
- Mixed-species restoration planting should consider both vertical and horizontal canopy development.

Planting Spacing Guidelines for Different Restoration Contexts

Planting Context	Recommended Spacing
Afromontane forest restoration – broad-canopy species (moderately degraded or enrichment planting sites)	3 m × 3 m to 4 m × 4 m (approximately 625–1,100 trees/ha) for broad-canopy Afromontane species such as <i>Cordia africana</i> , <i>Prunus africana</i> , and <i>Podocarpus falcatus</i> . Wider spacing reduces early intra-specific competition, promotes better individual tree growth and stand stability, and is appropriate where site conditions allow reasonable seedling survival without dense planting. A thinning schedule at years 3–5 is recommended where initial density exceeds 1,000 stems/ha.
Afromontane forest restoration – pioneer or colonizer species on severely degraded sites	2 m × 2 m to 3 m × 3 m (approximately 1,100–2,500 trees/ha) for fast-growing pioneer or colonizer species (e.g., <i>Croton macrostachyus</i> , <i>Albizia spp.</i>) on severely degraded land where rapid canopy closure is required to suppress aggressive grass and invasive weed competition. Density-dependent self-thinning and planned thinning at years 3–5 will naturally reduce stand density. Natural regeneration of indigenous species should be encouraged in the understorey as the canopy develops.
Coffee agroforestry: permanent shade canopy	8 m × 8 m to 10 m × 10 m (approximately 100–156 shade trees/ha) for long-lived canopy species such as <i>Cordia africana</i> , <i>Albizia gummifera</i> , and <i>Millettia ferruginea</i> . Final density should maintain adequate light penetration for coffee productivity.
Coffee agroforestry: intermediate or temporary shade	4 m × 4 m (approximately 625 trees/ha) for fast-growing shade species used during coffee establishment and early growth stages. Density may be reduced progressively as the permanent shade canopy develops.
Riparian buffer strips	Variable or irregular spacing that mimics natural vegetation patterns and accommodates existing regeneration. Buffer width should comply with local watershed management guidelines and site conditions, with priority given to native species that stabilize stream banks and protect water quality.
Boundary and farmland trees	4–6 m spacing along farm boundaries depending on species crown size and management objectives. Cluster planting near homesteads may be used for fruit trees, fodder species, medicinal plants, and other multipurpose tree species.

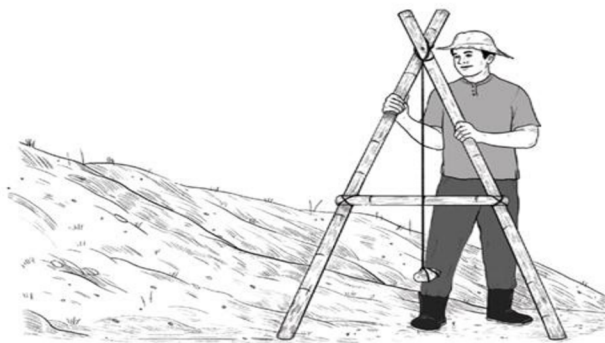
Adapted from: FAO (2013); FAO (2018); Oliveira (2021), ICRAF (World Agroforestry) agroforestry design guidelines; Ethiopian Ministry of Agriculture forest landscaperestoration and participatoryforestmanagementmanuals

FOLUR Alignment Note

- In degraded coffee gardens, the restoration target is to achieve a multi-strata canopy structure: emergent layer (20–25 m), sub-canopy shade trees (10–15 m), and the coffee shrub layer (2–3 m).
- Avoid monoculture planting of a single species. Aim for a minimum of 3–5 native species per restoration plot to build ecological resilience.
- Community-agreed land use plans must be in place before large-scale restoration planting to prevent future clearing.

How to establish a contour line using an A-frame

1. Starting in the middle of the slope, work from the bottom, moving upwards to minimize errors. Ensure that both legs of the A-frame are level.



2. Mark the position of one leg by placing a stake.



3. Move the second leg until the frame is 'levelled' and mark the position of the second leg using a stake.



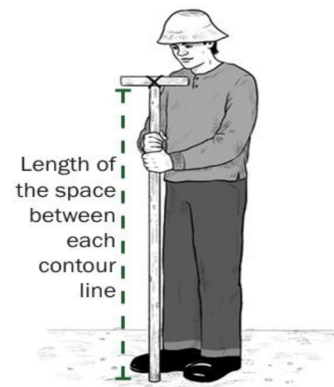
4. Continue the process until the end of the field.

5. Correct off-contour stakes to smoothen the contour lines.

Source: Adapted from Mercado (2019)

How to work uphill or downhill to establish the next contour line

1. Make a T-stick with the same length as the space between each contour line. The spacing of the contour lines may be based on the suggested spacing of fruit trees or forest trees (see Table 1). Only the height is important for the T-stick. Bamboo can be used because its poles are naturally straight.

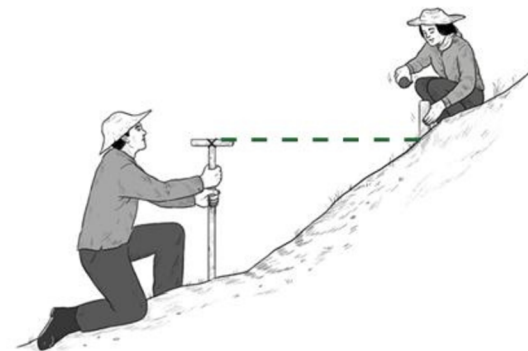


2. Going downhill: Go downhill and use the T-stick to sight a stake from the previous contour line. The top part of the stick must be level with the base of the stake; keep moving downhill until it is level. On steeper slopes, spacing between contour lines must be narrow compared with less steep slopes.



Going uphill: Another person must go uphill and hold the new stake for the next contour line. From a stake in the previous contour line, lay the T-stick and sight the stake being held by your partner; it must be level to the base of the new stake. Ask your partner to adjust by moving up or down until it is level.

3. Once the T-stick is level with the new stake, drive the stake forcefully to the ground. This will be the start of the new contour line.



Source: Adapted from Mercado (2019)

Staking

There should be an agroforestry plan and restoration plan that describes the kinds of species, spacings, arrangements, and management options for the farm or restoration site. After the planting site has

been cleared, refer to the plan and mark each spot intended for planting. Make sure that the markers are easily noticeable and driven deep into the soil to secure them.



Source: Adapted from Mercado (2019)

5.4 Planting techniques

5.4.1 Planting Depth

Correct planting depth is critical and one of the most common causes of early mortality in restoration plantings.

Planting Pit Preparation and Planting Specifications

Parameter	Specification
Pit dimensions(forest restoration species)	60 cm × 60 cm × 60 cm (minimum recommended size) to facilitate root development, improve water infiltration, and provide sufficient growing medium in degraded sites.
Pit dimensions (coffee shade trees and multipurpose trees)	40 cm × 40 cm × 40 cm is generally adequate for coffee shade trees and multipurpose species planted in cultivated landscapes where soil conditions are relatively favorable.
Planting depth	Position the seedling so that the root collar is at or slightly below ground level . The stem should not be buried above the root-shoot junction, as excessive planting depth can reduce survival and increase disease risk.
Backfill	Refill pits using excavated topsoil mixed with mature compost or well-decomposed farmyard manure. A ratio of approximately 1 part organic matter to 3 parts topsoil is commonly recommended where organic amendments are available.
Firming the soil	Backfill soil should be gently compacted by hand in layers to eliminate large air pockets around the root system while avoiding excessive compaction that may restrict root growth.

Source: Adapted from FAO (2013); FAO (2018); Ethiopian Ministry of Agriculture (2020); and World Agroforestry (ICRAF) guidelines on tree planting and agroforestry establishment.

5.4.2 Pit Digging

Digging holes can be done weeks before the actual planting if the soil is not hard. If done in advance, it will save effort, labor, and time and make the actual planting faster. However, during the actual planting,

you should bring a digging implement, like a hoe, pick mattock, or trowel, in case the holes have become covered or need adjustment. If hole digging will be done during actual planting, you should have company so that one can dig the holes while the other is planting the seedlings.

Locally available tools for holedigging

Tools are generally adapted to the characteristics of the terrain, the workability of the soil, and the preference of elderly, female and male farmers, especially regarding a tool's weight and the length of the handle. The following tools are often used for digging.

- An **oval blade hoe** is used to break generally loamy soil more easily. Use a hoe with a narrow blade for seedlings in containers and one with a wider blade for bare-rooted seedlings.



- A **pick mattock** is recommended for planting sites with stony and hard to break soils.



- A **dibble** or its alternative, a **digging bar**, is recommended when the site has sandy soil and when planting cuttings.
- A **shovel** is used to adjust hole depth and to carefully separate the topsoil from the subsoil.



Source: Adapted from Mercado (2019)

Mechanical hole diggers

Mechanical hole diggers, also known as augers or drill bits, can be used to make the hole digging process more efficient. If budget permits, these power tools can be used to increase productivity during site preparation. Generally, there are three types of earth augers:

- A **basic earth auger** has a long pole with a handle on one end that is held while twisting the tool to dig a hole in the earth.



- A **well-boring earth auger** is usually powered by petrol and lifted and lowered through a tripod-like structure.



- A **two-man auger** is the largest and most powerful type of earth auger. It is also powered by petrol. It can allow digging in any angle at the position that is required. Unlike the previous types, this mechanical hole digger is operated by two people.



Source: Adapted from Mercado (2019)

General protocol on hole digging

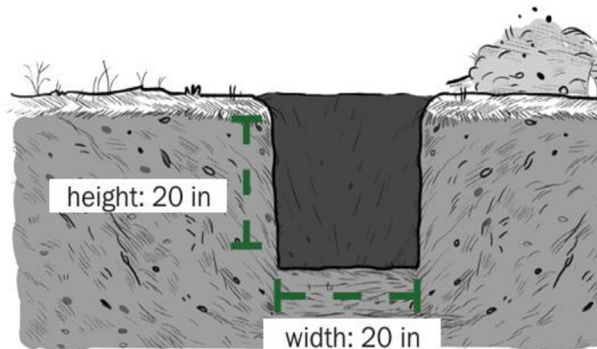
The area around the hole should be clear of vegetation to minimize competition with the seedling. Separate the topsoil from the subsoil.



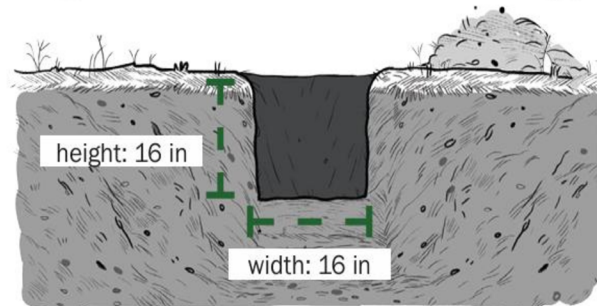
Source: Adapted from Mercado (2019)

Recommended hole sizes

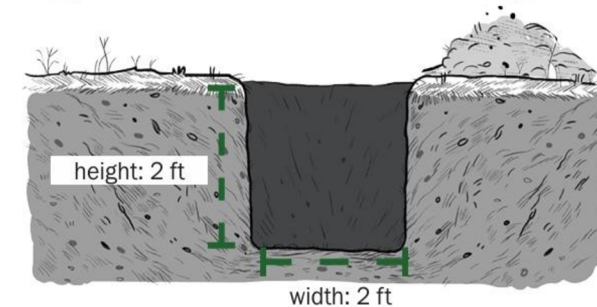
The recommended hole size is **20 x 20 inches (50 x 50 cm)**.



If the soil is soft, this hole size could have a size of **16 x 16 inches (40 x 40 cm)**.



If the soil is hard, this size could be bigger at **2 x 2 feet (60 x 60 cm)**. As a general rule: the heavier the soil, the bigger the hole.



Source: Adapted from Mercado (2019)

When digging out the soil, separate the topsoil (darker soil from the surface to 4 inches (10 cm) deep) from the rest. The reason behind this will be explained in the next parts.

5.4.3 Basal fertilizer and amendment application

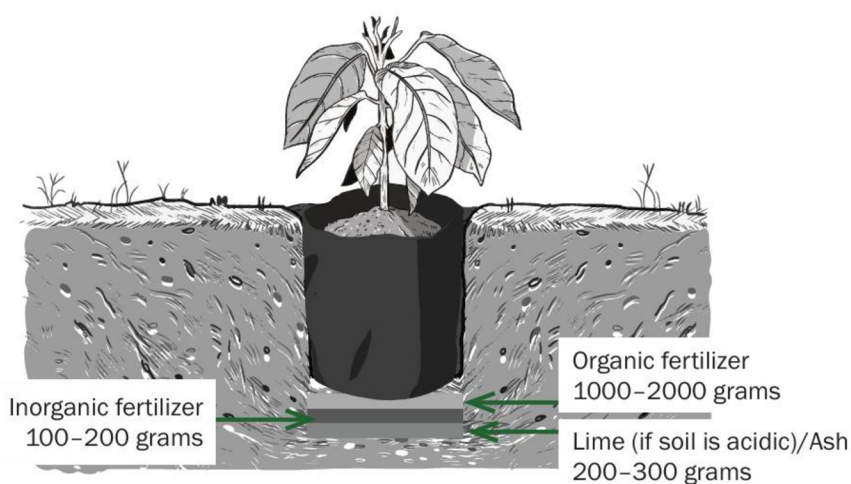
Organic and inorganic fertilizers or a combination of both, as well as other soil amendments, can be applied before outplanting the seedlings.

Summary of basal fertilizer and amendments

Soil condition Remark	Recommended additional inputs	Ratio (soil: additions)	Remarks
Normal condition	Organic fertilizer (composts)	-	1 to 2 kg of organic fertilizer, depending on hole depth
Acidic soil (pH <6)	Add liming agent (e.g. ash)	-	Optimum pH range for plants is between 6 to 7. Add at the bottom of the hole before any additions
Heavy clay	Add soil aerator amendment and manure	1 : 2 : 1	Soil aerators such as rice hull, sawdust, and sand
Sandy	Add manure or compost	1:2	Chicken manure is one of the best but do not use fresh manure because it has high nitrogen and ammonia content that may burn the roots. Use dried and well decomposed

Source: Adapted from EthioSIS (2016) recommendations and FAO (2015) Soil Fertility Management Guidelines.

- ❖ If the additions will be a combination of organic, inorganic, and soil amendment agents (such as lime), it is recommended to place the liming agent at the bottom of the hole, then the inorganic fertilizer, and finally the organic fertilizer.



Source: Adapted from Mercado (2019)

6. Transporting planting stocks

6.1 Considerations before leaving the nursery

Quality check

Always check these seedlings before taking them out of the nursery for outplanting. Seedlings exhibiting good quality will have a better chance of surviving field conditions. The following characteristics should be present on seedlings suitable for outplanting:

- a sturdy stem with a strong root collar;
- vibrant and healthy-looking leaves; and
- no signs of disease, fungus, or insect attack on any parts.

If a seedling does not show these characteristics, it should not leave the nursery for outplanting. Such seedlings should have been rejected at the production stage.



Grading

Grading is a physical assessment of each seedling before outplanting. This evaluates each seedling to see if it has the qualities discussed above. This is a strict process where the seedlings are grouped into classes.

- 1. First class** includes all the seedlings exhibiting the best characteristics.
- 2. Second class** covers seedlings that will still develop good characteristics as they grow.



- 3. Third class** is the “reject” group, containing seedlings that are frail or diseased.

The stocks in the third class should not be loaded for transport nor returned to the nursery. These should be placed at a distance to avoid accidentally including them for transport.

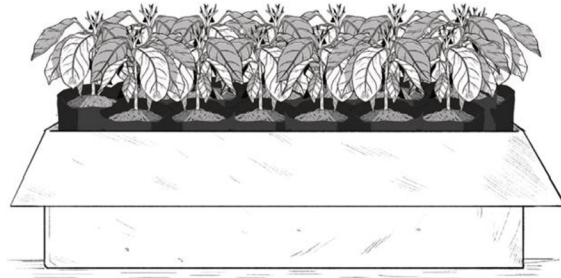


Considerations before transport

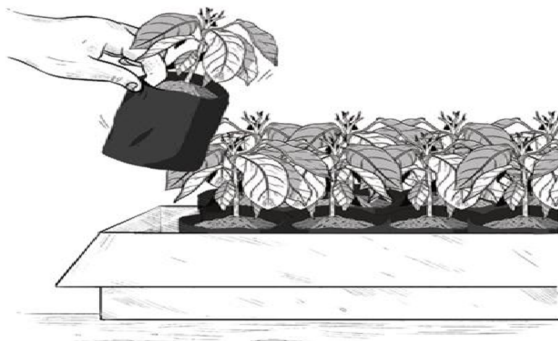
Seedlings must be packed well to prevent injuries and losses during transport. Replacing seedlings is expensive given all the effort, money, and time provided prior to outplanting.

- ❖ First and most important rule: All seedlings bound for the planting site must be thoroughly watered before leaving the nursery.

1. Use boxes or trays to load the seedlings in the vehicle.



2. When arranging the seedlings in the box or tray, always hold them on the edge of the container's opening. Holding a seedling by the stem will uproot it and gripping the containing might crush the roots, especially if done tightly.

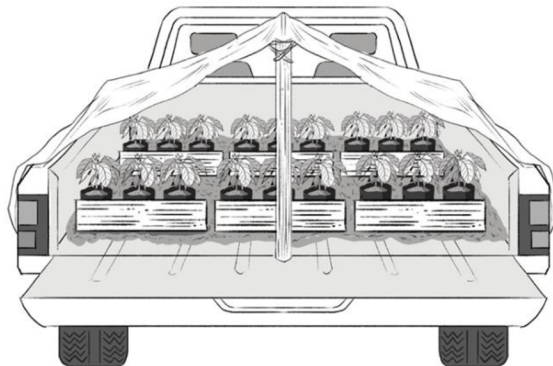


3. Be sure to load the seedling containers upright and set them in straight and compact lines.

6.2 Transporting the seedlings from the nursery to the planting site

Transport time should be as short as possible to lessen the exposure of seedlings to stressors, such as strong light and heat. The seedlings are still young and cannot tolerate harsh conditions yet.

- If using a hauling or pickup truck to transport the seedlings, protect the seedlings by laying an insulating material



- Usually, planting sites are not easily accessible by trucks or vehicles. In this case, the seedlings can be transported using backpacks and yokes.
- Carriers strapped to a house or a carabao can also be used to transport planting stocks.



Source: Adapted from Mercado (2019)

6.3 General protocols in outplanting seedlings

This section presents the usual process of outplanting. These steps will be modified in the next part to show adaptation to some possible unfavorable conditions in the planting site.

- ❖ **Note:** If possible, outplant on a calm cloudy day. Late afternoon is the best time. The seedlings must not be watered for two to three days before outplanting so that the soil holds together around the roots when you remove it from the bag.

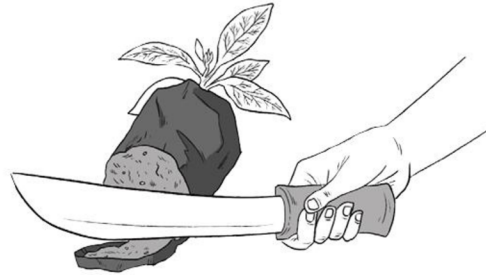
1. Fill the topsoil first back into the hole. The subsoil can be mixed with compost, if available.



2. Grasping the top edge of the seedling bag, lower the seedling into the hole to a point where the top edge of the container is level with the top of the planting hole. If it is not, add or remove soil until the container's edge is level with the top of the hole.



4. Remove the container from the hole. Lay it on its side beside the hole. Using a sharp blade, Slit the plastic bag from the bottom, leaving an inch or two from the brim. Make sure that the soil around the roots ('earthball') does not break apart.



4. Gently lower the seedling into the middle of the planting hole by supporting with both hands without breaking the earthball.



5. Fill the soil back into the hole until more than half of the bag's height is covered with soil.



6. Hold the seedling using one hand and gently slide the rest of the bag off the seedling.



7. Carefully firm the soil around the newly planted seedling by pressing it with your hands or heel. **If there are any air pockets around the earthball, the seedling will die.**



8. Check if the seedling is planted firmly enough by very gently pulling the plant. If it barely moves, then it is properly planted.



Source: Adapted from Mercado (2019)

Note: In case the earthball breaks up or totally crumbles away from the roots, just proceed with the rest of the steps but after firming (step 5), cut across all the leaf blades leaving a small part of each leaf intact. This will lessen evapotranspiration.

6.4 Adapting outplanting techniques to other site conditions

In addition to the outplanting process discussed in the previous section, below are some adapting techniques for several unfavorable site conditions.

Waterlogged areas

1. Do the planting before the rainy season while the site is still dry. This will give the seedlings time to adjust before being exposed to waterlogged conditions.



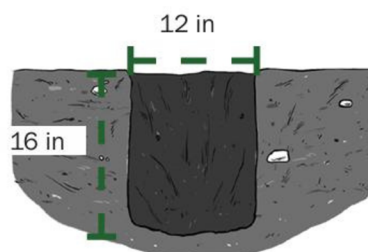
2. As you firm the soil, mound the base of the seedling after planting so that the top edge of the seedling container will be a thumb's

length (5 to 8 cm) higher than the ground. The mound will force excess water to drain away and not drown the seedling.

Dry sites

Choose seedlings with straight tap root and dense root hairs because this ensures efficient water uptake. To further ensure survival, techniques suited to the conditions should be applied, such as the following.

1. A 12 x 16 inch (30 x 40 cm) (W x H) hole is recommended for dry sites. A deeper planting hole will ensure better retention of moisture in the soil, thus increasing the seedling's chance of survival.



2. Follow the general planting procedures but the top edge of the container should be a thumb's length (5 to 8 cm) lower than the top edge of the hole.

3. After firming the soil, the base of the newly planted seedling should be sunken. Add mulch around the stem. The sunken base will collect water and the mulch will retain it.



Source: Adapted from Mercado (2019)

Eroding slopes and rocky sites

- Establishing contour lines is necessary (refer to page 11 of this manual for instructions on how to make contour lines) for slopes. Planting should be done along the contours.

- Weeding should be done sparingly; spot clear, if necessary. The vegetation's roots hold the soil from eroding further. This will also slow down any eroded soil from reaching the bottom.
- For planting sites that have very poor soil quality, add fertilizer and amendments at the bottom of the planting hole to provide nutrients for the seedling. Refer to page 18 for the basal fertilizer and amendment application.
- Aside from organic mulch, you may add pebbles around the newly planted seedlings.



Dos and don'ts in planting

Don'ts (X)	Dos (✓)
Obtain planting material from unreliable sources	Buy or source planting materials from reliable sources or accredited nurseries
Handle the seedling by holding its stem and/or holding the body of the container	Hold the brim of the seedling bag and not the body of the container or the seedling stem
Transport seedlings without ensuring adequate protection against drying	Cover the seedlings to avoid direct sun exposure during transport. If possible, transport at night.
Leave the plastic container on the seedling even after planting	Remove the bottom of the container carefully. Then, make a slit on the side of the plastic bag and pull the bag upward to fully remove it, while holding the stem of seedling firmly. Ensure that the earthball, or the soil clinging to the roots, is not disturbed.
Plant seedlings immediately	Give seedlings a week or two to recover from the stress of travel. Let them become used to the conditions at the planting site.
Plant in holes of wrong width and depth	Dig holes of recommended sizes. Small holes may cause the soil to be compact, thus stunting plant growth.
Plant seedlings with bent or twisted roots	Prune J-roots and curling roots before planting.
Fail to properly firm the soil around newly planted seedlings	Firm the soil around the newly planted seedlings to remove air pockets. Air pockets will dry out and kill the roots.
Shading the seedling for too long	Provide appropriate shading to the newly planted seedlings.

7. Post-Planting Care

7.1 Watering and Moisture Management

During the establishment phase (first 2–3 years), targeted supplemental watering during dry spells can be the difference between survival and failure: (*FAO Plantation Guidelines, 2018*).

- Water newly planted trees at intervals of 7–10 days during any dry period lasting more than 2 weeks within the main growing season.
- Use deep, slow watering (10–15 litres per tree) to encourage deep root development; avoid frequent shallow watering.
- In coffee agroforestry systems, coordinate tree watering with coffee irrigation schedules to reduce labour.

7.2 Mulching

Mulching is among the most effective and lowest-cost interventions for improving seedling survival in highland Ethiopia:

- Apply a 5–10 cm layer of organic mulch (dry grass, leaf litter, coffee pulp, crop residues) in a 60–80 cm radius around the base of each tree.
- Keep mulch 10 cm clear of the stem to prevent collar rot and rodent harborage.
- Refresh mulch layer at the start of each dry season; coffee pulp (widely available in project regions) is an excellent mulching material with soil amendment benefits.

7.3 Weeding and Vegetation Management

- Clear competing grasses and invasive plants within a 1 m radius for the first 2 years; manual weeding is preferred over herbicide use.
- Retain beneficial nurse plants and natural regeneration (wild seedlings) that are not competing directly with planted trees.
- In coffee gardens, coordinate shade tree weeding with coffee garden management schedules.

7.4 Pruning and Formative Shaping

- Begin formative pruning in year 2 to establish a single dominant stem for timber and shade trees.
- Remove dead, diseased, or crossing branches at the start of each dry season.
- For coffee shade trees, prune canopy to maintain 30–40% shade cover over coffee plants; too dense a canopy reduces coffee yield.
- Retain all pruning materials as mulch or compost; do not burn.

7.5 Protection from Livestock

Livestock browse and trampling is one of the leading causes of plantation failure in Ethiopia's mixed farming landscapes:

- Install physical protection (thorn brush enclosures, live fences of Cactus or Aloe) around restoration plots for a minimum of 3 years.

- Engage pastoral community members and kebele administrators in access agreements before planting.
- Use participatory area enclosure approaches where community-agreed seasonal closures to livestock can be negotiated.

8. Environmental and Social Co-Benefits

8.1 Carbon Sequestration and Climate Resilience

Well-restored Afromontane forests and coffee agroforestry systems are among the most carbon-dense terrestrial ecosystems. FOLUR Ethiopia is expected to avoid 7.28 million tonnes of CO₂ equivalent emissions through forest restoration and improved land management. Each restoration plot should be documented with GPS coordinates, species composition, and canopy cover to enable project-level carbon accounting. (IPCC, 2019; FOLUR Framework, 2023).

8.2 Biodiversity Conservation

The project regions sit within the Eastern Afromontane biodiversity hotspot. Restoration activities contribute directly to:

- Reconnecting fragmented forest patches to improve wildlife movement corridors.
- Increasing native woody species richness in degraded coffee landscapes (traditional coffee agroforests support up to 59% of native woody species found in intact forests).
- Reducing pressure on remaining natural forest through improved productivity of restored areas.

8.3 Livelihoods and Food Security

FOLUR Ethiopia integrates livelihood outcomes into restoration design. Tree plantation activities should deliberately include multipurpose species that generate income and food:

- Timber and construction wood (*Cordia africana*, *Juniperus procera*).
- Fuelwood (*Croton macrostachyus*, *Albizia* spp.).
- Fruit and NTFPs (wild enset, forest honey trees, medicinal plants, spices).
- Improved coffee quality and yield through optimized shade management.

8.4 Women's Economic Empowerment

Women play a central role in FOLUR Ethiopia's restoration and livelihood activities. Field implementation teams should:

- Ensure women hold at least 50% of paid roles in nursery management, planting, and monitoring activities.
- Register land and tree tenure rights in the names of women where legally possible.
- Facilitate women's access to NTFP harvesting and processing value chains linked to restored landscapes.
- Document participation data disaggregated by gender for project reporting.

9. Monitoring, Reporting, and Technology

9.1 Field Monitoring Requirements

All FOLUR Ethiopia restoration plots require systematic monitoring. At minimum, field teams should record:

Monitoring Indicator	Frequency & Method
Seedling survival rate (%)	Monthly for first 6 months; quarterly thereafter. Count surviving trees per plot.
Species composition	At establishment and annually. Record species, count, and health status per plot.
Canopy cover (%)	Semi-annually from year 2. Estimate using densiometer or photo-point method.
Invasive species presence	Quarterly. Record species and estimated coverage; trigger control measures if >10% cover.
Livestock damage incidence	Monthly. Record evidence of browsing, trampling, or enclosure breach.
Livelihood indicators	Annually. Record NTFP harvest volumes, employment days, income generated per household.

9.2 GPS Documentation and Geotagging

All planting activities under FOLUR Ethiopia must be geo-referenced for project accountability and carbon monitoring:

- Record GPS coordinates (latitude, longitude, elevation) for each restoration plot at establishment.
- Photograph each plot at establishment, 6 months, and 12 months with date-stamped images.
- Upload plot data to the project's digital monitoring platform (coordinate with Project Management Unit for access and training).
- GPS data is used for Green Legacy Initiative national reporting as well as FOLUR global programme progress tracking.

9.3 Adaptive Management

Monitoring data should drive management decisions, not merely fill reports:

- Plots with survival rates below 70% at 3 months should trigger immediate gap-filling replanting.
- Species failing consistently in a given site should be reviewed against site suitability criteria and alternatives identified.
- Quarterly field data should be reviewed by woreda-level technical teams and escalated to the regional FOLUR team for any systemic issues.
- Lessons from high-performing plots should be documented and shared through FOLUR's regional and global knowledge networks.

10. Community and Institutional Roles

10.1 Stakeholder Responsibilities

Actor	Role and Responsibilities
Community forest user groups (CFUGs) and PFM	Lead site selection, planting, weeding, and protection. Hold stewardship rights over restored areas.
Women's groups and cooperatives	Nursery management, sapling production, NTFP value chain development.
Kebele and woreda administration	Land access facilitation, livestock access regulation, integration with woreda development plans.
Regional forestry Bureau (Oromia, Sidama, South Ethiopia, Southwest Ethiopia)	Technical oversight, species selection guidance, policy alignment, reporting to national GLI.
FOLUR Ethiopia Project Management Unit (PMU)	Coordination, quality assurance, monitoring platform management, gender tracking, national and global reporting.
UNDP / World Bank	Programme oversight, co-financing management, global knowledge exchange.

10.2 Private Sector Engagement

The FOLUR Ethiopia Project actively engages the private sector from smallholder farmer cooperatives to coffee exporters and international buyers to mainstream sustainability across the coffee value chain. Tree plantation activities should be linked to deforestation-free coffee certification schemes and green finance mechanisms wherever possible.

- Work with coffee washing stations to source coffee pulp for mulching (mutual benefit)
- Engage coffee exporters in tree planting co-investment as part of supply chain sustainability commitments
- Link certified shade-grown coffee production to premium markets to demonstrate the economic value of restoration

Quick Reference: FOLUR Ethiopia Planting Checklist

Pre-Planting Checklist

- Site assessment completed (elevation, soil type, land use history, rainfall zone)
- Species list approved against ILUP and FOLUR species guidance
- Saplings sourced from certified community nursery; quality inspection passed
- Pit digging completed 2–3 weeks in advance; SWC structures in place on steep slopes
- Community agreement on livestock exclusion in place
- GPS plot boundaries and plot reference codes assigned
- Planting team composition documented (gender disaggregated)

Planting Day Checklist

- Planting during cool morning hours; saplings shaded during transport
- Pit backfill mixed with compost (1:3 ratio)
- Planting depth: root collar at ground level
- Mulch applied (5–10 cm layer, 10 cm clear of stem)
- Plot photo taken (geo-tagged) and data entered in monitoring form

First-Year Monitoring Checklist

- Monthly survival count; gap-filling for any dead trees within 30 days
- Weeding within 1 m radius every 2–3 months
- Dry season mulch refresh and supplemental watering as needed
- Livestock damage assessment monthly; enclosure repairs as required
- 6-month photo documentation and data upload to project monitoring platform
- Annual species composition and canopy cover assessment

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