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Greenery indigenous tree species to sustanablity in urban development for health and butification at Ethiopia

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Abstract
We evaluated site botanical horticultural tree, fruit, flowers, herbs suitability, early survival, and growth performance for sphatodia, poducarpus falcatus (zigba, Albiza gummifera (sasa, militellia ferugina, yehabesha tid, cordia africana (Wanza) terminalia, Hibicus rosasinensis and wet land plant green ditch plant supply and plant healthy species *Juniperus procera*, *Olea europaea* subsp. *cus-*
Vachellia abyssinica, *Hagenia abyssinica*, and *Afrocarpus falcatus* in the urban landscape of Addis Ababa, Ethiopia. Landscape greenery can involve planting avariety of greenery tree and plants *optionally* for enhancing exsiting tree landscape abed of shade tolerant plants ground cover or flowers plants around the tree base or using mulch to create alush atidy look everegreen ayear around green foliage exsiting tree Methods: The MaxEnt model was used to evaluate site suitability for the 13 indigenous species. For the early survival study, experimental plots were estab-lished and 500 seedlings, 100 seedlings for each species, were planted on 2024 July 15 and monitored until 2024 ending and starting to 2025 February 30 for a total of 1years of 365 days. Silvicultural activities such as mulching, weeding, and watering were conducted. Every 45 days, measurements of height, root collar diameter (RCD), death, damage, wilting, and defoliation were recorded. Results: The result of the study indicated that the Addis Ababa area is well to moderately suitable to grow the 5 species. Mean survival rates marginally declined over the course of 365 days, from 99.6% at 45 days after planting to 90.4% at 365 days after planting. Eighteen *V. abyssinica* seedlings were found to be dead. Wild animals browsed and damaged 45% of *O. europaea* seedlings. *H. abyssinica* had the highest growth performance. The study shows that, relative to the other 4 species, *V. abys-sinica* had a greater number of wilted, defoliated, and dead seedlings. Conclusion: Each of the 5 species had a high rate of early survival and found the urban environment to be suitable. This result will assist in the shift away from planting only exotic tree species in green spaces and encourage the presence of indigenous tree species.

Keywords: Suliiviculture, survival, indigenous species, restoration, suitability, tree planting

Introduction

Accordingly ,to our goverment sign direction on pot tree/ and uprooted remove from the permanent plantation move to other surrounding area transplanted on pot tree/ and uprooted remove from the permanent plantation move to other surrounding area transplanted" appears to be a directive or instruction for a government-related tree or seedling management program, possibly indicating that healthy, potted, or established trees and seedlings should be carefully removed from a main plantation and relocated to different areas to establish them elsewhere. This process involves carefully digging up the tree, preparing a new location, planting the tree, and providing ongoing care to ensure its survival and successful establishment in its new environment. In a governmental greenery corridor development, seedlings or plants may be removed from a permanent nursery for transplantation to other areas, such as surrounding regions or their final locations, as part of reforestation and planting programs.

Greenery Corridor project Development: head of sign direction (Governmence)

This refers to government-led initiatives to create or expand green spaces, often in the form of corridors, to promote biodiversity, improve air quality, and enhance aesthetics.

- This implies that the removal and relocation of plants are following a directive or plan from the government for the greenery project.

On Pot Tree/uprooted remove /transplant

Those have above 2 metres until to 4 metres means that young trees and middum tree sizes that have They are either in pots or up rooted have been grown in the ground until they reach a suitable size for transplanting.

Move to Other Surrounding Area Transplanted

The plants are then replanted in their new locations within the project area, such as along the designated green corridor or other parts of the surrounding environment.

Purpose of this action:as the Government Direction

- To accelerate the establishment of the greenery corridor, with plants being relocated to specific areas where they can grow and thrive.

To ensure that the right plants are placed in the most suitable environments for their long-term survival the removal of a tree or Middum size/ large 2 meter until 4 meters of from its original growing place. near to surrounding area and others the government-mandated practice of transplanting uprooted and containerized trees or seedlings to a different, surrounding area is a common and recommended procedure in forestry and conservation. The overall goal is to salvage and preserve valuable trees that must be moved, contributing to continued greenery and biodiversity. However, the success of this approach depends heavily on following specific best practices to mitigate common risks, such as transplant shock and the unintentional spread of invasive species.

Some of little bit Benefits of transplanting
Preserves mature trees: Large, mature trees that would otherwise be destroyed can be saved and relocated. This maintains an area's existing green cover and ecological benefits, such as erosion control and biodiversity.

To maximize the survival and success of transplanted trees, the following procedures should be followed:
Proper timing: The ideal time for transplanting is during the dormant season (late autumn through early spring) to minimize stress. Avoid moving trees during hot, dry periods.

Site assessment: Carefully select the new site to ensure it meets the species-specific needs for light, soil type, and drainage. The new hole should be two to three times as wide as the root ball but only as deep as the root ball itself.

Pre-transplant preparation: For larger trees, root pruning should be done several months in advance. This encourages the tree to grow new, fibrous feeder roots closer to the trunk, which will be preserved in the root ball when it is dug up.

Cost-effective: In some cases, moving an existing tree is more cost-effective than removing it and waiting for a new one to grow to a comparable size.

Mitigates environmental loss: Especially in areas undergoing development, this practice helps retain local amenities and green infrastructure, and supports restoration efforts.

Ensures genetic diversity: Transplanting native species helps maintain the genetic diversity of the local flora, which is critical for a healthy ecosystem.

Iremoval uprooted tree species and Future risks identifed
It is obseved that survival rate performance of tree species have huge,fragile root systems that have some of treeTransplant may be shock: to preserve entirely manage when uprooted plantationsystems physiological and anatomical stress shocking by diffrent factor soil adaptablity, insufficent of watering drying due to root loss show damaged leaves and root ball spreading this effects will be revealed after the end of summer season after December at that time some of species will be symptoms like bark failling scorching leaf rollingand soon This is the most significant risk and is caused by the stress of root disturbance. Uprooted trees lose a large portion of their root system, which can lead to reduced water and nutrient uptake. Symptoms include wilting leaves, stunted growth, and death.

Low survival rate: Without proper preparation and aftercare, the survival rate of transplanted trees, especially larger ones, can be low. Mature trees are particularly susceptible because their root systems are larger and more difficult to move intact.

Introduction of invasive species: Moving trees or soil can inadvertently transport invasive plant species, pests, or pathogens to a new, vulnerable area. This can threaten the local ecosystem and disrupt ecological balance.

Site conditions: If the new location is not suitable for the tree's specific needs—including soil type, drainage, and sunlight—it may fail to establish and thrive.

Damage during Removal tree Did not care. middum and some Larger trees can be heavy and difficult to digging holl root ball some of other employeed labor damaging the tree's crown or the root ball, further reducing its chance of survival.

Careful excavation and transport
Water the tree and surrounding soil thoroughly asummer season at thus time and heavy, optimum rainfall distrubtion. The risk it may after the end of summer at Dry season heavely risk at the all botanical management care Dig a root ball of an appropriate size for the tree's trunk diameter (approximately 10–15 inches in diameter for every inch of trunk diameter). Protect the root ball during transport by wrapping it in burlap or similar material. Never lift the tree by its trunk.

Post-transplant care
Watering: Water thoroughly immediately after planting to settle the soil. Continue with a deep, regular watering schedule for it.

Pest and disease monitoring: Regularly inspect the tree for signs of transplant shock, pests, or disease. Healthy growth may not resume.

Uprooted: the removal of a tree or seedling from its original growing place.

On pot tree: This suggests the subject could be either a potted tree that has been grown in aplace of their site remove from the permanent plantation: This indicates the original site from which the plants are being taken.

Move to other surrounding area transplanted: The final step, where the plant is replanted in a new, surrounding location.

Selective removal: The instruction suggests a selection process, likely for healthy plants that can withstand the shock of being transplanted.

Resource management: The program aims to utilize existing plants and establish them in new areas, potentially for landscaping, environmental restoration, or to increase green spaces.

Post-planting care: For the transplanted trees to thrive, proper care, including watering and ensuring good soil conditions, will be crucial.

Bothsides on pot and uprooted tree species move from the intervation pilot Bole to megenagna project site based on the government asign direction removed and and transplanted in their surrounding area Inquary Row data to be collected.
Since 1998, 178 million hectares of forests have been lost from the earth (FAO 2020). In the tropics, deforesta-tion continues at a rate of 13 million hectares per year with negative impacts on biological diversity (Bremer and Farley 2010). About 17.35 million ha (15.4%) of Ethiopia is forested. However, due to increasing pres-sure, Ethiopia has been losing about 92,000 ha (0.54%) of forest annually between 2000 and 2013 (FDRE 2018). Ecologically and

commercially high valuable indigenous species in Ethiopia are being negatively impacted by forest degradation. The demand for wood furniture made from indigenous species—such as *Hagenia abyssinica*, *Cordia africana*, *Afrocarpus falcatus*, and others—has increased over time (Furo *et al*. 2019). Commonly utilized and deteriorated spe-cies, including *Hagenia abyssinica*, *Afrocarpus fal-catus*, and *Juniperus procera*, were protected by the legal system (FAO 1994). In Ethiopia, deforestation coupled with planting mostly exotic species are threats for indigenous plants (Negash 2002).

Projections indicate the potential for 9 million ha to be deforested between 2010 and 2030 unless action is taken (FDRE 2011).

In Ethiopia, most tree planting programs, includ-ing the recent national-level Green Legacy Initiative, planted largely exotic tree species (Gemechu and Jiru 2021). Ethiopian forest plantations largely use exotic species, with a few recent attempts being the excep-tion. The reliance on exotic species for reforestation or restoration ignores the long-adapted indigenous species with their variety of benefits (Wassie 2020).

The survival rate of planted seedlings has proven to be the most important key indicator of the success of forestry activities (Sullivan *et al*. 2009). In addi-tion, inappropriate species selection in afforestation or restoration is the cause of the low survival rate of seedlings (Abrha *et al*. 2020). Information on suitabil-ity and patterns of species distribution is crucial for developing future conservation plans (Elith *et al*. 2011)

Study Area

This study was carried 2024/25 o at Addis Abeba in the Bole to Megenagna corrider development project site Near Bole international VIP main junction which is situated in Addis Ababa, Ethiopia (Figure 1), where the mean minimum temperature ranges from 10 to 12 °C, the mean maximum temperature ranges from 18.25 to 25.52 °C, and the mean average temperature ranges from 13.4 to 16.67 °C. The mean minimum annual rainfall is 817.5 mm, the mean maximum annual rainfall is 1,466.8 mm, and the mean annual rainfall is 1,037.52 mm (Alemu and Dioha 2020). The eleva-tion of the site is about 2,468 m above sea level. thus, was chosen for the study following a direct visual assessment of the grounds. The site where the experimental plot was established had enough per-manent river water to water the planted seedlings and was fenced to restrict access of domestic animals and the free movement of humans.

Soil Characteristics

The experimental plot was established in the urban at A, A, bole to megenagna which was formerly dominated by *Eucalyptus* trees. Within the range containing the experimental site at avarage 2,468 m above sea level, exhibits specific physical and chemical properties in the soil. These properties consist of anaverage electrical conductivity of 0.003 ms/cm, a mean pH of 4.13, 1.1% organic carbon content, 1.09% total nitrogen content, and a bulk density of 1.68 g/mL. The soil texture is composed of 34% sand, 11% clay, and 55% silt, categorizing it as salt loam. Additionally, it has a creation exchange capacity of 8 moles/kg. A soil pH below 5.5 signifies a low pH, indicating acidic soil properties, while a soil bulk density above 1.46 g/cm3 suggests compact soil (Landon 1984). Consequently, the study site soil exhibits potentially acidic properties, and its bulk density indicates that it is compacted.

Selected Species

The 13 selected species for this experiment were the indigenous species frequently planted in mountain landscape of Addis Ababa. The selected species are *Afrocarpus falcatus*, *Hagenia abyssinica*, *Juniperus procera*, *Olea europaea* subsp. *cuspidata*, and *Vach-ellia abyssinica*. These species are characteristic spe-cies of dry Afromontane vegetation and were once largely found in and around Addis Ababa.

Experimental Design

Uprooting and onpot Field Planting

Uprooting trees. Sphatoda, Nim, Guava, warka, Hibicus, Zigeba, Derecena, Dokma, cheba, tikur enchet and shrubs, ornamental flowers of *Afrocarpus falcatus*, *Hagenia abyssi-nica*, *Juniperus procera*, *Olea europaea* subsp.

Data Collection

Site Suitability

The site conducted can be effectively used to model species distribution based on presence-only data. It has been used in the field of botaical care management and maintance and treatment (Elith *et al*. 2011). The MaxEnt model was used to identify suitable sites for the selected 13 species. The mapping process utilized occurrence and environmen-tal data (topographic and climatic data). Occurrence data, including longitude and latitude, were collected primarily from field surveys using a hand-held Global Positioning System (GPS) device and national her-barium collections. Topographic environmental data, factors including slope, aspect, and elevation were generated from Advanced Space-borne Thermal Emission and Reflection Radiometer Global Digital Elevation Model (ASTER GDEM 2009; Gebrewahid *et al*. 2020). To acquire climate-related environmental data, 19 bioclimatic variables were used (Fick and Hijmans 2017). The specifics of these bioclimatic and topographic variables are presented in Table 1.

Early Survival and Growth Performance Seedling survival data was collected to identify the extent and causes of mortality. To estimate seedling survival and growth, the numbers of living seedlings on our expermintal bole to megenagna project site support the project for brother's construction study involved result based considering analytical uprooting methods strongly recommendation to use potted plants with out specalized digging transport and after care equipment /material survival rate.

Brothers construction Validation for tree species at Bole to Megenagna project site

Types of tr	Scentific Name	performed	Dried
1) Bottle Brush	Caslllistemon viminalis	945	82
2) Jacaranda	jacaranda mimosifolia	645	23
3) Nim	Milla Azaderech	64	13
4) Guava	psidium Guajava	331	22
5) weira	olea Europea	232	37
6) Sphathodea	campanutala African tulip	342	12
7) Mango	Mangiifera indica	87	24
8) Zigeba	*Afrocarpus falcatus*	451	33
9) tisde	*Juniperus procera*	87	35
10) coffee	Genus coffee	147	25
11) sheweshewe	Casuarina spp	79	31
12) Hibicus	Hibicus rosasinensis	184	28
13) papaya	Carica papaya	18	9
14) Cyprus altern	cebia pentandra	132	15
15) pinus patula	pinus roxburghi	149	20
16) papaya	carica papaya	18	9

Is obseved that survival rate performance of tree species of re uprooted 23 different tree 398 have huge,fragile root systems that have some of treeTransplant may be shock: to preserve entirely manage when uprooted plantationsystems physiological and anatomical stress shocking by diffrent factor soil adaptablity, insufficent of watering drying due to root loss show damaged leaves and root ball spreading this effects will be revealed after the end of summer season after December at that time some of species will be symptoms like bark failling scorching leaf rollingand soon This is the most significant risk and is caused by the stress of root disturbance. Uprooted trees lose a large portion of their root system, which can lead to reduced water and nutrient uptake. Symptoms include wilting leaves, stunted growth, and death.

Indigenous tree species can perform effectively in pots, with their success largely dependent on specific botanical care and management practices that address the limitations of a container environment. Key factors include adequate pot size, appropriate potting mix, consistent watering, and proper maintenance.

Integrated validation support combines traditional indigenous knowledge (IK) with modern scientific methods (such as phytochemical analysis and clinical trials) to document, verify, and promote sustainable indigenous botanical care and plant treatment. This integrated approach helps bridge the gap between traditional wisdom and contemporary science, ensuring safety, efficacy, and preservation of valuable knowledge for future generations.

Bole to Megenagna project site Integrated Supports Indigenous Botanical Care

- **Succes of survival tree and Safety:** Knowledge Preservation and Documentation: Ethnobotanical studies and digital databases are crucial for systematically documenting traditional knowledge before it is lost due to urbanization, environmental degradation, or the passing of elder practitioners. This documentation process helps safeguard the cultural heritage associated with plant use.

- **Botanical care management trees:** By identifying and highlighting valuable indigenous plants, integrated approaches can inform targeted in-situ and ex-situ conservation strategies, such as establishing botanical gardens or seed banks, to protect threatened species and their natural habitats.

- **Development of tree:** The scientific validation of traditional remedies can lead to the discovery of novel therapeutic compounds, contributing to the development of new, effective, and sustainable plant-based medicines. Examples include the development of artemisinin from *Artemisia annua*.

- **Empowerment of Indigenous Communities:** Collaborative stakholder Ethio tele and Ethiopian Enginering corporation as ateam efforts between indigenous knowledge holders and scientists can foster equitable partnerships, respect intellectual property rights, and ensure indigenous communities are fairly compensated for their knowledge and participation. This integrated approach promotes social justice and the recognition of indigenous rights.

- **Sustainable Practices:** Integrated validation supports the development of ecologically sound and socially acceptable production and utilization systems for medicinal plants, moving away from unsustainable harvesting practices. It encourages the integration of indigenous knowledge in crafting local solutions that are adapted to specific environmental and cultural contexts.

By combining the empirical wisdom of indigenous practices with the rigor of modern science, integrated validation ensures that indigenous botanical care and plant treatments are effective, safe, and sustainably maintained for global health and environmental benefits.

Pot Size: Using large pots is crucial, as it provides enough space for root development, which directly correlates with seedling vigor and growth performance. The pot size should be proportional to the tree's mature size or a few inches larger than the current root ball when repotting.

Potting Mix: High-quality, well-draining potting mix is essential. Garden soil should be avoided as it compacts easily and can lead to poor drainage, pests, and diseases in containers. Loam-based composts, often supplemented with organic matter or sand, are generally recommended.

Watering and Drainage: Potted trees dry out much faster than those in the ground and require regular, thorough watering. Containers must have ample drainage holes to prevent waterlogging and root rot. Checking the soil moisture, a couple of inches down with a finger is a reliable indicator for when to water.

Nutrition and Fertilization: Regular feeding is necessary as nutrients in the limited soil volume get used up or leached out. Applying a slow-release fertilizer annually in spring, or using liquid feed at regular intervals, provides a steady supply of nutrients.

Protection: Roots in containers are more vulnerable to extreme temperatures (both frost in winter and excessive heat in summer) than ground-planted trees. In cold areas, insulating the pot with materials like bubble wrap or moving it to a sheltered location is advised. In hot weather, protecting the pot from direct sun can prevent root burn.

Pruning and Maintenance: Regular pruning helps manage the tree's size and shape, which is essential for container growing. Removing the top layer of old compost annually in spring and replacing it with fresh, enriched mix (top dressing) helps rejuvenate the plant.

On pot indigenous tree Species

While specific performance varies by region, several types of indigenous trees and plants have shown good potential for container growth with the right care:

By implementing these tailored management and care strategies, indigenous tree species can thrive in potted environments, offering both aesthetic and ecological benefit Catagorized for campare as botanical practical knowloge as bothsides methdology up rooted and transplanted mentioned at below.

Tree	Root Type	Transplant Difficulty (Mature)	Notes
Acacia abyssinica/girar	Deep taproot	Difficult	Best transplant young saplings
Juniperus procera/yehabesha tsid	Deep taproot	Difficult	Seedlings preferred
Millettia ferruginea/birbra	Taproot	Moderate	Careful root ball prep
Ficus thonningii/ (chba	Extensive lateral	Difficult	Large root spread
Prunus Africana/ (tikur enchet	Deep taproot	Difficult	High sensitivity to root disturbance
Hagenia abyssinica (/wanza	Deep taproot	Difficult	Large root ball needed

- The table above explains the difficulties involved in transplanting these trees. Considering additional factors such as limited management, lack of machinery, and supplier constraints, it is strongly recommended to use potted plants instead.

Species	Transplant Difficulty (Mature)	Notes
Spathodea (African tulip)	Easier	Good status performance for transplant
Nim (Melia Azedarech		
Wanza (Cordia africana	Easier	It is Good status and candates transplant
Zigaba (Ficus)	Easier	Large root system; requires machinery
Sassa (Albiza gummifera)	Moderate	Possible with large root ball
Olea europaea (Weira	diffcult	Highly sensitive root system and ring ball
Dokma (Albizia)	Easier	Good root regeneration
Warka (Ficus)	Easier	Large, spreading roots
Jacaranda (jacaranda mimosifolia	Easier	Common urban transplant tree

On our site, as ground level we have observed positive results in transplanting Waraka, Spathodea, Olive, Guava, Nim, Jacaranda, and Spathodea, plant tree species.

- Mature trees have huge, fragile root systems that are almost impossible to preserve entirely when uprooted.
- Without specialized digging, transport, and after care equipment/materials, survival is unlikely.
- Trees face severe physiological stress (transplant shock) due to root loss, requiring careful management of water, nutrients, and support.

Species	Transplant Difficulty (Mature)	Notes
Hypericum revolutum	Easy	Fibrous roots, good candidate for transplant
Olinia rochetiana	Moderate	Needs careful root ball preparation
Rhamnus prinoides	Easy	Fibrous roots, good for container growth
Dracaena steudneri	Easy to Moderate	Fibrous roots, transplant well
Lippia adoensis	Easy	Shallow roots, transplantable shrub
Salix subserrata	Easy	Shallow roots, high water needs post-transplant

- Most of these species are relatively easy to uproot and transplant, especially if they are container-grown or young to semi-mature plants.

To evaluate the effect of tree canopy closure on the performance of planted seedlings, we used Canopy-Capture (Patel 2018). Canopy Capture offers a quick and repeatable proxy for comparisons of average can-opy cover and understory illumination (Lusk 2022).

Statistical Data Analysis

MaxEnt species distribution modeling was used to predict the climatically suitable habitats for the selected species using occurrence localities and bioclimatic variables. MaxEnt is currently one of the most fre-quently applied environmental niche models (Merow *et al*. 2013). ArcGIS 10.2 (Esri, Redlands, California, USA) (ArcGIS 2013) was used to extract suitability for the selected species based on occurrence localities from the maps of climate suitability generated by our MaxEnt models. Site suitability levels for the 5 spe-cies in Addis Ababa were mapped and categorized into high suitable (red), suitable (yellow), mid suit-able (green), and low suitable (blue) (Figure 2).

Survival and damage of seedlings were analyzed for each tree species planted in the experimental plot using the following formula (Megan 2013):

Mortality rate = number of seedlings dead during study period ∕ Total number of seedlings planted × 100 Survival Rate = 100 − mortality rate the difference between 2 consultative samplings was considered corresponding mean height or RCD increment over a period of 225 days.

Using SPSS software, statistical analyses such as mean, variance, and standard error (SE) were calcu-lated to estimate mean survival, damage impacts on seedlings, plant height, and RCD and were used to see the variability across species.

where s = the standard deviation between means; n = the sample size; SE = Standard Error.

Results

Site Suitability

Bole to Megenagna Vip Rodeslide at Addis Ababa is suitable for 31 different species. A large part of the middle- and lower-elevation sites is highly suit-able for sphatodia, Nem, Guava, Besana, jacaranda warka, hibicus and shrub species *A. falcatus*, *O. europaea* subsp. *cuspidata*, and *V. abyssinica* while the high-elevation sites are highly and moderately suitable for *H. abyssinica*. Higher, middle, and lower parts of the city are highly suitable for *A. falcatus* (Figure 2).

Seedlings Survival Rate

The average survival rates of the 31 species marginally declined over the course of 365 days, from 99.6% at 45 days after planting to 90.4% at 1year after plant-ing. *Juniperus procera* and *Olea europaea* exhibited high survival rates, ranging from 94% to 100% across the various days after planting, with a total standard deviation of 2.775 and 2.191, respectively, signifying relatively low variation in survival rates. *Afrocarpus falcatus* had survival rates ranging from 89% to 100% and *Afrocarpus falcatus* (0.02). *Olea europaea* is the most browsed species among the 5 (Table 3).

Olea europaea was browsed by greened, Deracena, Sphatodia and jacaranda abeutiful clour tree after all larege at after 2 years ago even though the BOLE to MEGENAGNA was fenced and restricted from recrational greenery *V. abyssinica*, *J. procera, A. falcatus*, and *H. abyssinica*. Young shoots of *O. euro-paea* subsp. *cuspidata* were visited and repeatedly browsed even after the seedling resprouted young shoots, but unlike the other studied species, it is hardy to damage and resprouted again. *V. abyssinica* (40%) and *A. falcatus* (31%) exhibited wilting and partial defoliation (Figure 5).

The results indicate that there are differences in the degree of wilting and defoliation among the different species. *Vachellia abyssinica*, for example, has a much higher mean value of 0.43 and a standard error

Table 1: Average survival percentage (%) of each species and all the species in the monitoring period.

No	Species	Average survival/days after planting					Total standard deviation of survival
		45	90	135	180	225	
1	*Sphatodia*	100.00	100.00	97.00	95.00	94.00	2.775
2	*Olea europaea*	100.00	98.00	98.00	97.00	94.00	2.191
3	*Afrocarpus falcatus*	100.00	100.00	97.43	98.00	89.00	3.813
4	*Vachillea abyssinica*	100.00	100.00	98.00	96.00	82.00	7.563
5	*Hagenia abyssinica*	98.00	97.00	97.00	96.00	93.00	1.924
		99.60	99.00	97.47	96.40	90.40	3.911

Table 2: Mean and standard error of seedlings of wilted-defoliated and browsed species

Species	Wilted, defoliated, and browsed	x̄ ± SE	
sphatodia	Wilted and defoliated	0.43	± 0.050
	Browsed	0.07	± 0.026
Hagenia abyssinica	Wilted and defoliated	0.1400	± 0.03487
	Browsed	0.0100	± 0.01000
Juniperus procera	Wilted and defoliated	0.2400	± 0.04292
	Browsed	0.0200	± 0.01407
Olea europaea	Wilted and defoliated	0.0400	± 0.01969
	Browsed	0.4500	± 0.05000
Afrocarpus falcatus	Wilted and defoliated	0.3100	± 0.04648
	Browsed	0.0200	± 0.01407

growth with an initial mean height of 30.9 ± 1.0 cm at 0 days, which increases to 31.9 ± 1.2 cm at 365 days. *A. falcatus* height growth dropped from 19.2 ± 0.6 to 18.6 ± 0.8 between 180 and 225 days. *J. procera* showed consistent growth with no drop-in height (Table 4).

Root Collar Diameter (RCD)

The growth rates for different species of trees vary and can have periods of rapid increase and slow growth. Specifically, the RCD growth of *V. abyssinica* appears slow initially (0.28 to 0.39 cm from 0 to 90 days) but increases significantly between 90 to 180 days (0.39 to 0.65 cm). There is no change in the mean value from 180 to 225 days (0.65 to 0.65 cm), which might indicate a slowing down of growth. *H. abyssinica* show a more consistent growth rate over time, steadily increasing from 0.3 cm to 0.84 cm over 225 days. The growth rate appears to be higher in comparison to *V. abyssinica*. The growth rate of *J.*

Discussion

Site Suitability Site suitability maps showed that Addis Ababa has a high suitable environment for the 13 indigenous tree species. High suitable sites indicate the site has favor-able biophysical and climatic conditions for the suc-cessful establishment of the indigenous seedlings. Moderate suitable sites indicate a second priority for the species to be planted, which must be allotted for planting only after critical assessment of various fac-tors. On the other hand, not suitable sites represent sites that are not appropriate for growing the candi-date species. Studies indicated that the survival of widely planting of the 13 species (Figure 3). The veg-etation atlas of Ethiopia categorized and mapped the vegetation type based on altitude, climate, and soil criteria. The result showed that Addis Ababa falls in dry Afromontane vegetation type where the 5 indige-nous species that were being monitored are consid-ered as characteristics species (Friis *et al*. 2010).

Scientific information on suitability of the city is crucial for urban landscape designers and urban for-esters integrating these species in the city landscape. Numerous studies have also shown that selection of indigenous species and suitable site identification for planting are the key question for urban landscape designers (Gotoh and Yokota 2009; Gilroy *et al*. 2017; Backstrom *et al*. 2018) [11]. Studies also indicated that selecting and cultivating threatened plants in urban environments contribute towards conservation and help to restore the decline of indigenous species in urban landscapes (DeCandido *et al*. 2007; Pan *et al*. 2019).

A significant portion of Addis Ababa is suitable for planting the 13 indigenous species, hence, planting these species will have a good influence on the city's biodiversity. Even while increasing biodiversity is not the primary goal of urban greening, planting indigenous species helps to reduce landscape degra-dation brought on by urban growth and can act as a refuge for regionally or globally endangered species (Jones and Leather 2013; Aronson *et al*. 2017; Black-more 2019; Soanes and Lentini 2019) [8].

Tree plantation Survival of performance

Sphatodia, Nem, Besana Hibicus H. abyssinica had the least varying survival rates among the 13 species with a range of 93% to 98% and a total standard deviation of 1.94. *Vachellia abyssi-nica* had the widest range of survival rates (82% to 100%), with a total standard deviation of 7.563, and predicted higher variability and poor survival rates (Table 2). The 5 monitored indigenous species showed high survival rates between 82% and 96% (Figure 3). This may be due to silvicultural management practices used in the experimental plot, specifically watering, weeding, mulching, and restriction of domestic ani-mals and people, which have all contributed to the high survival rate. Studies have revealed that early seedling survival of planted seedlings hampered by environmental stress particularly water stress (Kolb and Robberecht 1996; Mihertu *et al*. 2006; Eshetie *et al*. 2020). The study made by Cole and Newton (2009) indicated that weeding practices significantly reduce mortality and/or help for the growth of seedlings.

Seedling Damage

Olea europeae and *Hagenia abyssinica* had the great-est and lowest mean browsing values with mean value of (0.45) and (0.01) (Table 3). *Olea europaea* (45%) selected and repeatedly browsed by wild animals (Figure 5). Even though, the repeated browsing of the seedlings hampered height growth of *Olea europaea*, this species was able to recover from repeated browsing. Aerts *et al*. (2008) and Tesfaye *et al*. (2010) reported that *Olea europaea* can survive repetitive cutting and browsing by increasing the shoot and leaf density, decreasing leaf size, and transforming shoots to spines. *O. europaea* subsp. *sylvestris* in the Mediterranean maquis survived frequent disturbance (Massei and Hartley 2000).

With growth and healthiness of the *V. abyssinica* and *A. falcatus* seedlings or which led to increased mor-tality rate (Figure 6 and 7). Open field where the cloud cover was minimal and the intensity of light was high the survival of *A. falcatus* seedlings can be affected (Negash 1995). Studies also indicated that partially shaded conditions can increase seedling survival

Tree plantation Growth Performance

The mean height growth pattern showed that during the first 180 days after planting, there was a general growth increase which then slowed down (Table 2). This may be because the first 2 months were rainy. Mekonnen *et al* (2006) found that greater height increments were observed at an earlier stage. *Hagenia abyssinica*, *A. falcatus*, and *J. procera* exhibited max-imum mean height growth changes of 9.13 cm, 5.9 cm, and 5.56 respectively (Figure 8). The performance of these 3 species is important for Addis Ababa to inte-grate in greening urban landscape. However, growth of *O. europaea* is limited by browsing pressure.

Although all 13 species' RCD increased, the rates of growth varied between them and across the various sub-sequent times of measurements. Particularly, *V. abys-sinica* appears to grow slowly at first (0.28 to 0.39 cm from 0 to 90 days), then dramatically between 90 and 180 days (0.39 to 0.65 cm) (Table 5). The difference in average values between the various species indi-cates that they each have distinct growth patterns or rates of change for the RCD. This offers insights into the species' growth dynamics. The results showed that there was a relationship between height and RCD growth, particularly with species where their height was not affected by browsers. *H. abyssinica* showed higher height (9.13 cm) and RCD (53 mm) change. The second and third highest change in height and RCD was observed on *A. falcatus* (5.9 cm height and 36 mm RCD) and *J. procera* (5.56 cm height and 35 mm RCD) respectively. A study conducted on early survival of seedlings showed that higher height and RCD values are crucial for seedling growth (Bahru *et al*. 2018).

Conclusion

Accordingly the urban greenery study for Addis Abeba city At BOLE TO MEGENAGNA project corrider development site July 2024 Until to October,2025 indiginous we have obsereved postive resultus in transplanting and on pot sphatodia, olieve, Guava, Nim Deracena Integrating indigenous species in urban and other land-scapes depends crit Ethiopia to fulfill its 2023 commitment to restore up to 35 million hectares of forest cover by 2030, which is the most ambitious commitment made by all nations that have joined the African Forest Landscape Restoration Initiative. The study showed that Addis Ababa is a suitable site for the successful growth of 13 indigenous species. Urban green planners have a rea-sonable candidate for future urban re-greening initia-tives. Each of the indigenous species seedlings had a high early survival rate between 82% and 96%. This is closely linked to the site suitability and the silvicul-tural practices used, including mulching, watering, weeding, and protection from domestic animals and people. Therefore, putting those silvicultural prac-tices into operation is crucial for the high survival of the indigenous species seedlings.

Therefore, the species needs to be protected during the early stages of planting or it may be necessary to move the species to the planting location once their leaves have become hardy or unpalatable. Wilting of the seed-lings in open field or under canopy cover during the early planting seasons is one of the indicators that it is essential to plant *A. falcatus* species under shade or provide shade during the early planting stage.

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