YARDO-SL

with support from

IKI INTERNATIONAL CLIMATE INITIATIVE

ENVIRONMENTAL MANAGEMENT & FOREST CONSERVATION

TRAINING MANUAL

2023

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PREFACE AND ACKNOWLEDGEMENTS

Youth Action for Relentless Development Organization Sierra Leone (YARDO-SL) was established in 2014 as a youth led environmental focused NGO working across all the various regions in Sierra Leone.

For about a decade now, YARDO-SL has worked towards building bridges between existing knowledge on sustainable environmental management and the communities that need this knowledge to inform their willingness to lead action, while working toward poverty reduction and environmental sustainability.

The YARDO-SL's work has been carried out following three key objectives:

1. Promoting dialogue and improving the exchange of knowledge, information and methods within and between stakeholders on sustainable environmental management, and linking existing and emerging networks and initiatives.

2. Generating new knowledge, promoting understanding and providing guidance relevant to the development and implementation of national environmental policy, plans and processes focused on reducing vulnerability and strengthening the resilience of the poor, young people and women.

3. Facilitating young people's participation in sustainable environmental management and poverty reduction practices at the local, national and regional levels.

This purpose of the Training Manual aligns with these objectives.

YARDO-SL has been supporting many youth groups across various communities around the country to strengthen their capabilities to mainstream environmental education, research, awareness raising, and policy advocacy to promote environmental stewardship at grass-root level.

Its ultimate goal is to assist the country to build resilience through the mobilization of knowledge and best practices, enhanced institutional capacity, informed decision making processes, and facilitated change of attitudes, with young people at the center of achieving this goal.

YARDO-SL remains grateful to the management of the National Protected Area Authority and National Water Resource Management Agency, for their active participation in the development of this manual.

Finally, we are grateful to the IKI Small Grants Program for providing the funding for the project: Strengthening Youth and Women's Action for Sustainable Protection of the Guma Water Catchment, of which this manual is a product.

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ABOUT THIS MANUAL

This training manual was developed by Abraham Gassama (Msc. Environmental Management and Quality Control) with support from Ahmid C Jalloh, Alpha Dumbuya and David Moiba.

It is aimed that it provides community-based youth environmental trainers and learners with a wealth of practical environmental management knowledge, and a proper understanding of conservation practices for forest management.

The manual is sectioned into three (2) training modules:

The first module, 'Introduction to Environmental Management and Environmental Concerns' is very comprehensive, as it provides in simpler terms, a better understanding of the context of environmental management and concerns in Sierra Leone, and the second module is more practical as it navigates principles of forest conservation with focus on growing forests through nursery establishment.

Each module is comprised of several learning sessions, completed with participatory exercises/quizzes. Importantly, many sessions have suggested reading materials. It is an advantage to the trainer and trainee/participant that these be reviewed, as this would provide further context and knowledge to enhance the learning experience. YARDO-SL encourages all trainers and learners to follow the module process, particularly ensuring that vocabulary in learned as a starting point, and appropriate focus and time are given to competing exercises.

However, note that this manual was written in a way that can be used introductory level training on environmental management and Forest conservation. YARDO-SL also sees great value in environmental practitioners, rural development workers, and or natural resource managers adapting and innovating with the tools and processes put forth to fit differing environmental contexts, culture, levels of facilitation skills, and needs.

Suggested Training Schedule

Day 1	Module 1: Environmental Management	Morning	Afternoon
		Principles of Environmental Management, Deforestation, Floods,	Pollution, Wildfires, Climate Change
Day 2	Module 2: Forestry	Morning	Afternoon
		Principles of Forestry, Ecosystem Services	Nursery Establishment Forest Protection

Please note that each Module is divided into topics, which are referred to as sessions. Each session has its own time depending on the nature and length of the topic, however it is advised that at least a session does not last longer than 40 minutes. If this advice is adhered to, that means it will take about 3-4 hours a day to deliver a module.

MODULE 1

INTRODUCTION TO ENVIRONMENTAL MANAGEMENT

Learning Objectives:

By the end of this module, the learner/trainee should be able to:

1. Clearly explain the context of environmental management
2. Analyze major environmental concerns in Sierra Leone

Learning/Teaching Materials Required: Whiteboard/Screen/flip chart, markers of different colors

Duration: 40 minutes

Principles Environmental Management:

Human beings very survival in this planet Earth depends on the proper management of environment. Every living species in this plant require air, water for survival. All living beings are interdependent directly or indirectly. The survival of trees and forests will bring good rainfall and good agriculture.

The climatic condition depends on the air temperature. Everyone is now feeling the change of climate due to the rise in air temperature of the earth. More presence of carbon dioxide is resulting global warming, ozone layer depletion and acid rain. All these environmental hazards are happening due to imbalances in the surrounding air.

Every living body need clean air, water and soil for survival and healthy life. Due to enormous increase in population and stress on environmental factors like air, water and soil, it is now urgently needed to frame guidelines and rules for the management of environment in a proper way. A good management of environment can only bring a sustainable life to all in this planet earth.

Therefore, **Environmental Management** can be defined as "the **management** of the interaction and impact of human activities on the natural **environment**". ... **Environmental management** tries to identify the factors that have a stake in the conflicts that may rise between meeting the needs and protecting the **environment.**

Scope of Environmental Management

The awareness regarding environmental problems and their proper management began in 1970s through various people movements around many countries of the world. The green peace movement, the Chipko movement etc. are some of them. The advancement in the field of science and technology helped to provide various tools and instrument supported by statistical data to properly solve environmental problems and help in its management.

The revolution in the field of computer technologies has now provided us enough means to utilize this in the area of environmental management. There are now very advanced instruments to measure air and water qualities at different places. The soil testing procedure adopted now can give very accurate result about the quality and nutrient quantities of soil at different areas.

The rapid growth in population along with rapid industrialization has put much stress on environmental factors like air, water and soil. Many forest areas have given way to establish factories. Large amount of industrial waste polluting the air water and soil in the surrounding areas. This pollution is not limited to one place.

It is spreading too many areas of population. This pollution of environment has become a global issue. It requires help from all sections of people in the society. People around the world are now very conscious about the health of the environment. Due to development in all branches of science and technology, there is enough scope for environmental management in the present time.

Environmental Management in Sierra Leone

The Government has formulated a range of sectorial policies, regulatory and institutional frameworks that deal with natural resource (forestry, wildlife, minerals, fisheries, etc.) management, protected area system management and biodiversity conservation. Two key pieces of instruments, namely the National Environment Policy (NEP) and the National Environmental Protection Act (NEPA), were enacted in 1994 and 2000, respectively, to cover environmental management in the country.

Created by an Act of Parliament on the 11th September, 2008 Titled "The Environment Protection Act, 2008" amended in 2010. . Mandates includes: ♣ Environmental policy making and planning: The Agency formulates national environmental policies. ♣ Overall coordination with relevant MDAs: The Agency is in charge of coordination of all environmental management programs. ♣ Enforcement and Compliance: The Agency initiates legislative proposals, standards and guidelines on the environment in accordance with the Act. ♣ Environmental Impact Assessment Licensing: The Agency reviews and approves environmental impact assessments and statements submitted in accordance with the Act.

In 2019, Government created the Ministry of the Environment in Sierra Leone through an act of parliament. This is a clear indication of H.E President Bio commitment to protect the environment for sustainable development. The ministry has been active in executing its mandate of overseeing and coordinating the activities of all environmental-based government agencies, NGOs, CBOs and other development partners in the country. It has also been very active in environmental policies and regulations formulations and/or review. As a matter of fact, the ministry is currently rolling out the biggest tree planting project in the history of Sierra Leone aimed at planting 5 million trees in 4 years (2020-2023) across all districts in Sierra Leone to restore tree cover and diversity loss, restore depilated lands, and provide jobs and livelihoods.

Here's a list of some agencies under the newly formed ministry of the environment:

	Agencies	**Key Function**
1.	**National Protected Areas Authority (NPAA)**	**Protects of reserved areas such as national parks and its biodiversity**
2.	**Forestry Division**	**Regulates all forest related activities**
3.	**Environmental Protection Agency (EPA)**	**Enforces general environmental compliance**
4.	**Sierra Leone Meteorological Agency**	**Monitors all weather forecasts for safety**
5.	**National Disaster Management Agency**	**Mitigate and response to disasters**

Challenges in Environmental Management in Sierra Leone

- Low literacy rate:

Sierra Leoneans way too often don't even know the impact of their actions, because they simply don't have the education to understand the consequences. Most environmental defaulters do not simply see any wrong in their doings. Example, A "charcoal producer" illegally operating within the Guma Water Catchment, according to a survey report from YARDO-SL, do not know that the deforestation activity he was doing have the tendency to reduce water (quality and quantity) supply to the entirety of Freetown, which will affect over a million lives.

- Poverty

Sticking with the charcoal producer example above, he blamed poverty for his action. After been asked if he will stop deforestation of the Guma Water Catchment, he responded that if he stops he won't have any livelihood for his family. YARDO-SL have been working with him, supporting him with skill training on alternative livelihood, which will shift his focus from charcoal production to sustainable vegetable production. This method has helped in reducing the burden of livelihoods from the reserved forest.

- Lack of technical & financial support to environmental agencies and its implementing partners

Most of the agencies in the environmental sector are understaff, with few technical experts in the field. This has negatively affected their operations especially in the areas of public education and compliance enforcement. Lack of adequate finance support too has been a reason for the slow growth/progress of most of these environmental agencies. However, with the little they have, these agencies have shown a great sign of potential growth over the last few years.

- Poor political will

This refers to the contradicting efforts from various stakeholders to effective manage the environment. A good political will can ensure that all stakeholders, no matter their political affiliations, comply with the set environmental regulations or policies. Example can be seen in the Western Area where people are building houses within the greenbelt of the Western Area Reserve National Park, they remain unbothered because of their connections.

Benefits of Environmental Management in Sierra Leone

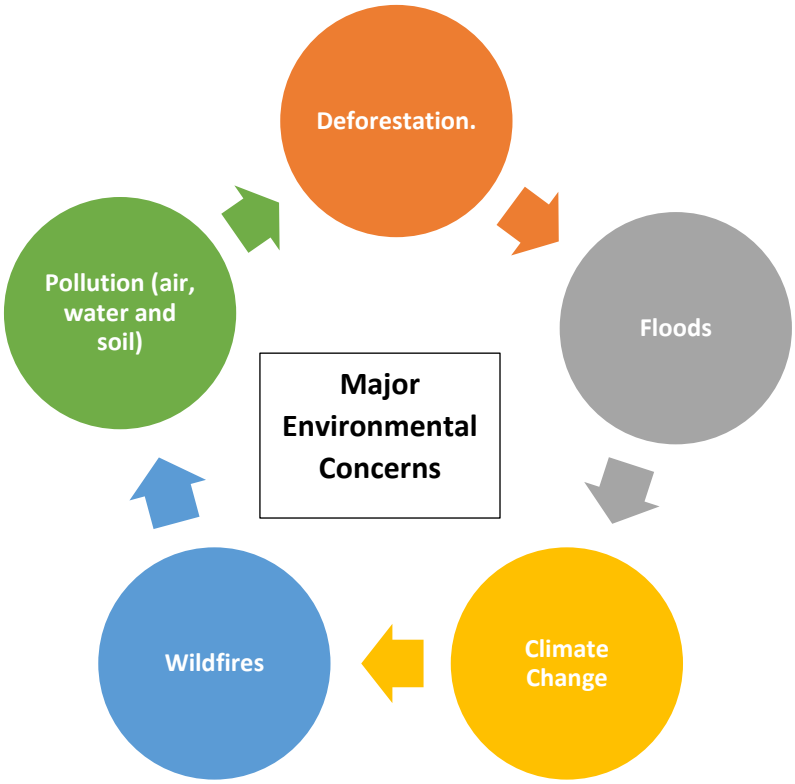
Studies suggest that there are important opportunities for a transition to a green economy, that would create more social well-being, including better health, and more jobs and economic progress, while at the same time reducing environmental risks, such as the effects of air pollution, inappropriate waste management, greater water scarcity, the loss of eco-services, and climate change. Overall, it improves the quality of human life.

ENVIRONMENTAL CONCERNS IN SIERRA LEONE

By way of definition, Environmental Concerns refer to any serious threat to human beings and their **environment** due to the continuous and accelerating overuse and destruction of natural resources.

There are so many environmental concerns in Sierra Leone, which actually depends on who and where you ask. Every community has its own unique environmental concern. For example, people in Tombo community are more concerned about the deforestation of the mangrove swamps whereas people in Lunsar are more concerned about the pollution of their streams from oil deposits at the mining sites. But for the purpose of this training, YARDO-SL have largely grouped this environmental concerns into 5 groups. It is also important to note that these concerns are inter-related and inter-connected. That means, one can directly or indirectly leads to another. Example, deforestation can accelerate water run off which can result to floods.

A necessary condition in addressing **environmental concern** is to advance knowledge about the effects and consequences of the ongoing **environmental** deterioration for future generations, empower community participation and also enact strict policies geared towards solving the problem.



1. **Deforestation**

Background

Deforestation, clearance, clearcutting, or clearing is the removal of a forest or stand of trees from land that is then converted to non-forest use.

Deforestation is becoming increasing alarming across the world, not just in Sierra Leone. Forests still cover about 30 **percent of the world's** land area, but they are disappearing at an alarming rate. Between 1990 and 2016, the **world** lost 502,000 square miles (1.3 million square kilometers) of forest, according to the **World** Bank—an area larger than South Africa.

For this training, let us keep the focus on the Western Area National Park and examine deforestation at a local scale.

The pressures of the rapidly expanding city are taking an increasing toll on the Western Area National Park forest expanse in and around Freetown, with the fringes of the city rapidly pushing up into the mountains of the forested peninsula – leading to a tree cover loss of 12% or 555 ha per year between 2011 and 2018. Such an expansion fueled by intense deforestation is a critical cause for concern, as the forested area lost and under threat provides vital functions for the city, such as a catchment for water reserves (water supply to the City of Freetown) and as a protector against natural hazards including landslides, flooding and coastal erosion. Compounded by impact of climate change tree and vegetation cover loss in Freetown and the Western Area peninsula has also created loss of biodiversity and habitat in the forest and woodlands system along the Freetown peninsula as well as the systematic destabilization of high slopes and creating the context of the free flow of water which increases sediment into the river and dam systems and will over time result in a loss of water capacity of the reservoirs and thus limited access to water for Freetown and the recurring threat of natural hazards and threats to critical infrastructure, life and property.

Key causes

- Agricultural Activities
- Charcoal Production
- Illegal Logging.
- Urbanization.
- Quarrying.
- Mining.

Effects

The loss of trees and other vegetation can cause climate change, desertification, soil erosion, fewer crops, flooding, increased greenhouse gases in the atmosphere, and a host of **problems** for indigenous people who rely on the forest for water, food, ecotourism and other needs.

Recommended Solutions to Stop or Reduce Deforestation

Raise awareness on the dangers of deforestation
Engage in Reforestation of deforested lands
Join campaign against deforestation
Avoid any activity that will lead to deforestation

2. **Pollution**

Background

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat, or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

There are **three (3) main types of pollution**: water **pollution**, air **pollution**, and land **pollution**. All of these can be found in mostly urban areas.

There is not enough data to examine the level of pollution over the years. However, it is evidently clear that over the past months, the level of water pollution is becoming worrisome with ongoing artisan mining activities along the bank of major rivers in Sierra Leone. The change in the colors of the river to mud (yellowish) can be clearly seen by anyone passing through the Sewa River Bridge in Kono.

Key causes

- Household activities. Eg. Smoke from cooking, improper handling of toxic or organic waste etc
- Industrial Emission. Eg. Smokes from factories, Oil spillages as well
- Wildfires. Eg. Smoke and heat waves
- Agricultural activities Eg. Use of chemicals such as pesticides and fertilizers can pollute the air & water
- Transportation Eg. Smoke from vehicles, ships and airplanes pollute the air

- Open Burning of Garbage Waste Eg. Smoke from burning of wastes in dumpsites
- Mining Eg. Digging of pit holes and oil spillages from machines.

Effects

The effects of pollution cannot be underestimated as it direct affects human health. Clean water, clean air and clean land/surrounding are requisite for a healthy and safe living. It also affects livelihood because most communities rely on rivers/marine ecosystems for survival.

Recommended Solutions to Stop or Reduce Pollution

Pollution can be reduced through processes such as recycling and the proper handling and treatment of waste. The reduction of corporate fossil fuel extraction and usage is another way to counter pollution. Public education, and enforcement of environmental compliance as well.

3. **Floods**

Background

Flooding is an overflowing of water onto land that is normally dry. **Floods** can happen during heavy rains, when ocean waves come on shore, when snow melts quickly, or when dams or levees break. Damaging **flooding** may happen with only a few inches of water, or it may cover a house to the rooftop.

Recent events in Sierra Leone have actually shown how vulnerable the country is to flooding. Maybe it is because of the lack of proper urban planning structures, but places like Bo, Makeni, Freetown Etc. report flooding, almost every year. Some come with a greater damage/loss, others not as much.

The most memorable flood event in the history of Sierra Leone is the one that happened on the 14th August 2017 in Freetown which eventually resulted to a landslide at the Regent Community, and nearly claimed 1,500 lives with so many property worth billions of Leones are destroyed as well.

Key causes

Floods are the most frequent type of natural disaster and occur when an overflow of water submerges land that is usually dry. **Floods** are often **caused** by heavy rainfall, rapid snowmelt or a storm surge from a tropical cyclone or tsunami in coastal areas. However, it is also important to note that human activities such as rampant deforestation, dumping plastic waste on gutters and building on waterways, as in the case of Freetown, have accelerated the frequent rate of flooding.

Effects

Needless to say, Flooding can adversely affect human health (pollution of wells), and in some cases even leads to deaths and destruction/damage of property. It has, even a greater on the socio-economic status of the society, as it threatens livelihoods dependent on agriculture.

Recommended Solution to Stop or Reduce Floods

Introduce better flood warning systems

Engaging in the tree planting along the slope of hills

Keep gutters clean

Avoid blocking/constructing on waterways

Raise awareness and enforce compliance

4. **Wildfires**

Background

A wildfire, bushfire, wildland fire or rural fire is an unplanned, unwanted, uncontrolled fire in an area of combustible vegetation starting in rural areas and urban areas. It mostly happens in the dry seasons.

Wildfire is not too often reported in Sierra Leone as studies have shown. However, they have had a devastating impact on not just an individual life, but a whole community, for all the places where wildfires have been reported so far.

In other parts of the world, wild fires can be attributed to natural causes such as thunderstorms and Heat storm. But in Sierra Leone, although there is no significant data to substantiate this claim, but almost 99% of the wild fires are manmade.

Key causes

- Agriculture Eg. Burning of farm lands
- Urbanization Eg. Clearing and burning of large acres of land for construction
- Fire accidents Eg. Domestic fire accidents like home burning from use of candle or oil spillage during cooking. Industrial fire accidents are common as well, example when fire catches an operating engine inside a grassland/forest.
- Careless Smoker Eg. Throwing away a cigarette butt in grasslands during the dry season have started so many fires

Effects

Wildfire can destroy a whole community; lives and property. It can burn farms, houses, schools, schools etc. It is one of the most dangerous environmental concern in Sierra Leone, albeit it is impressively low.

Recommended Solutions to Stop or Reduce Wildfire

Raise awareness

Educate farmers and builders how to create fire belt before they start clearing and burn vegetation

Enforce compliance.

5. **Climate Change**

Background

Climate change refers to a significant variation in either the average state of climate or in its variability, persisting for an extended period (typically decades or longer). Natural processes may cause climate change or be caused by external – human related - events that cause long term changes in the composition of the atmosphere or in land use.

Global warming is a term that describes the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century. Since the early 20th century, Earth's average surface temperature has increased by about 0.8 °C, with about two-thirds of the increase occurring since 1980. Scientists are more than 90% certain that global warming is caused by increasing concentrations of greenhouse gases (Carbon dioxide, Water vapor, Methane, Nitrous Oxide, and Ozone) produced by human activities such as the burning of fossil fuels and deforestation.

Climate Change is one the key global issues as it is evidently affecting all spheres of human life. In Sierra Leone we are already facing the negative impacts of climate change. For example, everyone in Freetown will agree that the City is becoming warmer than it is used to be few years ago. Also there's an unpredictability of rains this days that is highly affecting farmers and food supply.

Mitigation measures are those actions that are taken to reduce and curb greenhouse gas emissions. Example: Government banning the use of fossil-fuel cars for electric cars, planting more trees to increase the carbon sinks etc.

Adaptation measures are based on reducing vulnerability to the effects of **climate change**. These include proactive measures such as crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, famine early warning systems, insurance, water storage, supplementary irrigation and so on.

Key causes

Human activity is the main **cause** of **climate change**. People burn fossil fuels and convert land from forests to agriculture. Since the beginning of the Industrial Revolution, people have burned more and more fossil fuels and changed vast areas of land from forests to farmland, hence the rise in global temperatures.

Effects

Increased heat, drought and insect outbreaks, all linked to **climate change**, have increased wildfires. Declining water supplies, reduced agricultural yields, health **impacts** in cities due to heat, and flooding and erosion in coastal areas are additional effects of climate change.

Recommended Solutions to Stop or Reduce Climate Change (emissions)

Stop deforestation and plant more trees for carbon sinking

Public Education, Raise awareness and Mobilize community for climate action

Stop or reduce using fossil fuel

Embrace clean renewable energy like solar energy

Engage in climate-smart agriculture

REFERENCES FOR MORE READING

https://thecalabashnewspaper.com/new-minister-of-environment-re-growing-forests-must-be-a-major-national-development-program/

https://youmatter.world/en/definition/climate-change-meaning-definition-causes-and-consequences/

http://www.rrcap.ait.ac.th/Publications/BUILDING_CLIMAT_%20RESILIENCE_CBA_Training_Manual.pdf

PARTICIPATORY QUIZ

1. What do you understand by environmental management? List three bodies responsible to manage the environment in Sierra Leone and outline their key mandate.
2. In your own words, list an environmental concern affecting your community, highlight the causes and suggest actions to overcome these concerns.

MODULE 2

INTRODUCTION TO FOREST CONSERVATION

PRINCIPLES OF FORESTRY CONSERVATION

Learning Objectives:

By the end of this module, the learner/trainee should be able to:

1. Clearly explain the meaning of forest, forestry and forest conservation
2. Analyze benefits of forests and various types of ecosystem services.
3. Practically understand how to establish a nursery

Learning/Teaching Materials Required: Whiteboard/Screen/flip chart, markers of different colors, tools for nursery work

A ***forest*** is defined as "A plant association predominantly of trees or other woody vegetation occupying an extensive area of land" by the American Society of Foresters.

Forestry on the hand means, "The science, art and practice of managing trees and forests and their associated resources for human benefit" according to Canadian Forest Service.

Whereas***, Forest conservation*** is the practice of planning and maintaining forested areas for the benefit and sustainability of future generations. Forest conservation involves the upkeep of the natural resources within a forest that are beneficial for both humans and the ecosystem.

Classes of Forests based on Objectives

1. Protection of Environmental Forestry (Protection of land, regulation of water cycle, Wild life conservation Modernization of climate conditions, combination of above)

2. Commercial or Production Forestry (Timber and other raw materials)

3. Social Forestry (Raising forests outside the traditional forest with the involvement of society)

i) Community Forestry (The practice of forestry on lands outside the conventional forest area for the benefit of local population and involvement of community in the creation and management of such forests)

ii) Farm Forestry (Raising forest trees on farms lands

iii) Extension Forestry (includes the activity of raising trees on farm lands/ villages wastelands/ community forest areas/ road side areas, canal banks and railway lines.

iv) Agro-Forestry (a sustainable land management system which increases the yield of the land by combining agriculture crops and forestry crops together on the same piece of land)

v) Recreational Forestry (Enhancing scenic beauty near towns and cities)

Benefits of Forests

A) Direct benefits

i. Timber uses (commercial use as well as non-commercially. The timber uses in construction houses, manufacture of windows, doors and furniture etc. Wood-based panel and paper/paperboard)
ii. Uses as fuelwood and charcoal
iii. Fodder for domesticated animals

iv. Non-timber forest products (NTFP) such as wild edibles, latex, wild cocoa, honey, gums, nuts, fruits and flowers / seeds, spices, condiments, medicinal plants, rattan, fodder, fungi, berries and also includes animals and their products

B) Indirect Benefits

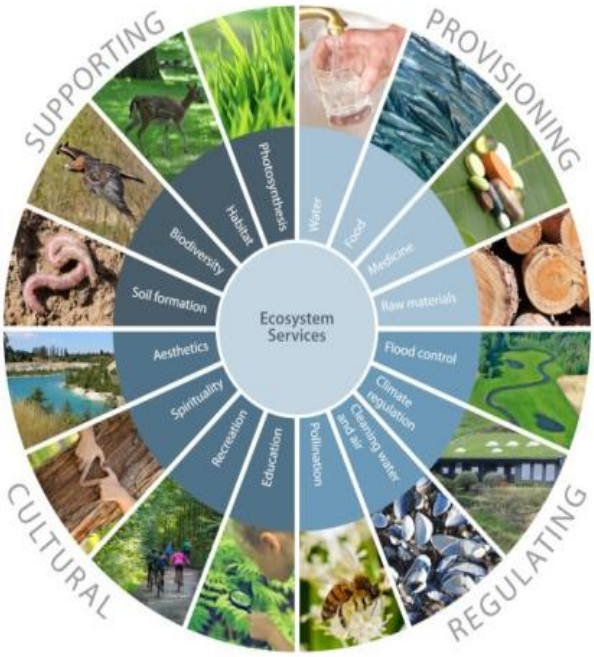
i. Conservation of Biological Diversity
ii. Watershed protection
iii. Arresting landslides and erosion
iv. Control of floods
v. Recharging of natural springs
vi. Carbon storage and sequestration
vii. Tourism and recreation values

ECOSYSTEM SERVICES

Ecosystem Services are the direct and indirect contributions ecosystems (known as natural capital) provide for human wellbeing and quality of life. This can be in a practical sense, providing food and water and regulating the climate, as well as cultural aspects such as reducing stress and anxiety.

1. Provisioning Services

When people are asked to identify a service provided by nature, most think of food. Fruits, vegetables, trees, fish, and livestock are available to us as direct products of ecosystems. A provisioning service is any type of benefit to people that can be extracted from nature. Along with food, other types of provisioning services include drinking water, timber, wood fuel, natural gas, oils, plants that can be made into clothes and other materials, and medicinal benefits.



2. Regulating Services

Ecosystems provide many of the basic services that make life possible for people. Plants clean air and filter water, bacteria decompose wastes, bees pollinate flowers, and tree roots hold soil in place to prevent erosion. All these process work together to make ecosystems clean, sustainable, functional, and resilient to change. A regulating service is the benefit provided by ecosystem processes that moderate natural phenomena. Regulating services include pollination, decomposition, water purification, erosion and flood control, and carbon storage and climate regulation.

3. Cultural Services

As we interact and alter nature, the natural world has in turn altered us. It has guided our cultural, intellectual, and social development by being a constant force present in our lives. The importance of ecosystems to the human mind can be traced back to the beginning of mankind with ancient civilizations drawing pictures of animals, plants, and weather patterns on cave walls. A cultural service is a non-material benefit that contributes to the development and cultural advancement of people, including how ecosystems play a role in local, national, and global cultures; the building of knowledge and the spreading of ideas; creativity born from interactions with nature (music, art, architecture); and recreation.

4. Supporting Services

The natural world provides so many services, sometimes we overlook the most fundamental. Ecosystems themselves couldn't be sustained without the consistency of underlying natural processes, such as photosynthesis, nutrient cycling, the creation of soils, and the water cycle. These processes allow the Earth to sustain basic life forms, let alone whole ecosystems and people. Without supporting services, provisional, regulating, and cultural services wouldn't exist.

FOREST PROTECTION AND ITS LAWS

Despite its many benefits, forests are globally under threats. However the threats vary from country to country, regions to regions etc. Therefore, the more reason why forest protection (through robust laws and regulations) have been prioritized in this 21st century. It is aimed to help build systems where human and nature can co-exist in a sustainable manner.

Sierra Leone as a country has since put forward laws to help protect the forests and its natural resources. Examples of such major laws below:

Forestry (Amendment) Act of 2022 **-** is an Act to amend the Forestry Act, 1988 and to provide for other related matters. This Act provides for amending the Forestry Act no. 7 of 1988. The amendments concern: replacement of definitions concerning responsible authorities and institutions; updating of offences and related penalties for illegal cutting, burning, damaging and destroying trees or vegetation, removal of timber or other forest products, animal grazing, cultivation of crops, obstructing forest officers.

Forestry Act of 1988 **-** This Act replaces the Forestry Act of 1912. It is based on the recommendations of an FAO technical assistance project, which suggested legislation providing more explicitly than previously for forest management. The Chief Conservator of Forests is made responsible for the management of the forest resources of the country. He is required to compile a national inventory of forest resources and a national forest management plan designed to obtain the "optimum combination of economic, social and environmental benefits. Most of the management provisions of the Act apply only to classified forests, which may be either national or community. A national forest is required to be on State-owned or -leased land, in contrast to reserves under the previous law which were generally on chiefdom (customary) land. As under the previous law, existing usage rights compatible with the purpose of the forest are to be preserved. Acquisition or leasing of land for national forests is subject to normal provisions for compensation. Previously, compensation was not usually paid in respect of areas put into forest reserves, although a part of any timber royalties was given to chiefdom authorities. A classified forest may have protection or production as its primary

purpose, but in both cases it is to be managed for the maximum combination of benefits compatible with the primary purpose. Detailed inventories of classified forests may be required by regulation.

Forest Policy 2010 **-** Part 3 of the present Forestry Policy 2010 establishes that the long-term vision for forestry is to move towards an integrated forest sector that achieves sustainable, rights-based management of forests for economic, social, cultural, aesthetic, and environmental benefits for the present and future generations of the country.

The National Protected Area Authority and Conservation Trust Fund Act, 2012 **-** Being an Act to provide for the establishment of the National Protected Area Authority and Conservation Trust Fund, to promote biodiversity conservation, wildlife management, research, to provide for the sale of ecosystems services in the National Protected Areas and to provide for other related matters

GROWING A FOREST (NURSERY ESTABLISHMENT)

What is a Nursery?

A place where plants are grown commercially, either for sale direct to the public or to other retailers. OR; An area where we grow and nurse young progeny (an offspring of a person, animal, or plant) of plants is called Nursery.

A plant nursery is a place where plants are propagated, grown, and sold for gardening or landscaping purposes. Nurseries may specialize in a particular type of plant, such as annuals, perennials, herbs, vegetables, fruit trees, or shrubs or they may offer a wide variety of plants for sale.

Some nurseries also sell gardening supplies, such as soil, mulch, fertilizers, and potting containers. Many nurseries offer advice to customers on how to care for the plants they have purchased, and some may also offer landscaping or garden design services.

Forest Nursery

A forest nursery is a place where trees and other woody plants are propagated and grown for the purpose of reforestation, afforestation, or landscaping. Forest nurseries may specialize in a particular type of tree, such as conifers, deciduous trees, or fruit trees or they may offer a wide variety of woody plants for sale.

The plants grown in a forest nursery are often used to reforest areas that have been damaged by logging, fire, or other disturbances, or to establish new forests in areas where trees are not native.

Forest nurseries may also grow trees for use in landscaping projects, such as parks and gardens. In addition to growing trees, many forest nurseries also sell seedlings, saplings, and other small plants, as well as forestry supplies, such as mulch, soil, and fertilizers.

Forest nurseries help to ensure that there is a sufficient supply of trees to meet the demands of these industries and to restore and protect forests that have been damaged or destroyed.

Purpose of Nursery

The primary purpose of a plant nursery is to propagate and grow plants for sale to the public. Nurseries may specialize in a particular type of plant, such as annuals, perennials, herbs, vegetables, fruit trees, or shrubs, or they may offer a wide variety of plants for sale. Nurseries may also sell gardening supplies, such as soil, mulch, fertilizers, and potting containers.

Some nurseries may also offer landscaping or garden design services, as well as advice on how to care for the plants that they sell. The plants grown in a nursery are often used for home gardens, public parks, and landscaping projects.

- Nurseries are used for artificial plantation. We raise nurseries in those areas where natural regeneration is low or slow.
- Nurseries are raised to get plants of the right size at the right time.
- Nurseries are raised to get such plants which are good in health.
- Nurseries are raised to get plants of the desired spp.

Types of Nurseries

There are many types of nurseries:

- Temporary Nursery
- Permanent Nursery
- Containerized Nursery
- Field Nursery
- Forest Nursery
- Commercial/Economic Tree Nursery

Factors to consider in Nursery Establishment

A. Site Selection

The selection of the area for a nursery is critical and it should be sited as centrally as possible to the field(s) to be planted. In addition, the following should also be considered:

Topography (Terrain)

The selected area should be flat to gently undulating with slopes between 0 and 30 and preferably, with a reliable/permanent source of water supply for irrigation purpose.

Water Supply

Water requirements (quality and quantity) must be determined prior to starting site preparation. The easiest source of water is where there is a large natural pond or lake whereby all that is required is to place an intake pipe to connect with a pump unit. A back-up system should be considered, particularly in isolated areas or areas of lower or unreliable rainfall.

Drainage

The site chosen should not be prone to flooding, which will damage seedlings and buildings (stores).

Area

To achieve good growing conditions with minimal risk of etiolating, a main nursery planting density of 13,800 polybags per ha with 0.91m(3ft) x 0.91m(3ft) D planting is recommended excluding allowance for accessibility. The spacing should be increased by another 0.15m (0.5ft) if the seedlings are anticipated to be kept in the nursery for longer than 12 months.

Accessibility and Nursery Roads

Roads within the nursery and their alignments will need to be carefully planned and laid out depending on the placement distance of the polybags and the type of irrigation to be utilized. Access roads to the nursery should be sufficiently wide to allow vehicles to maneuver during peak planting periods to facilitate supervision and movement of materials.

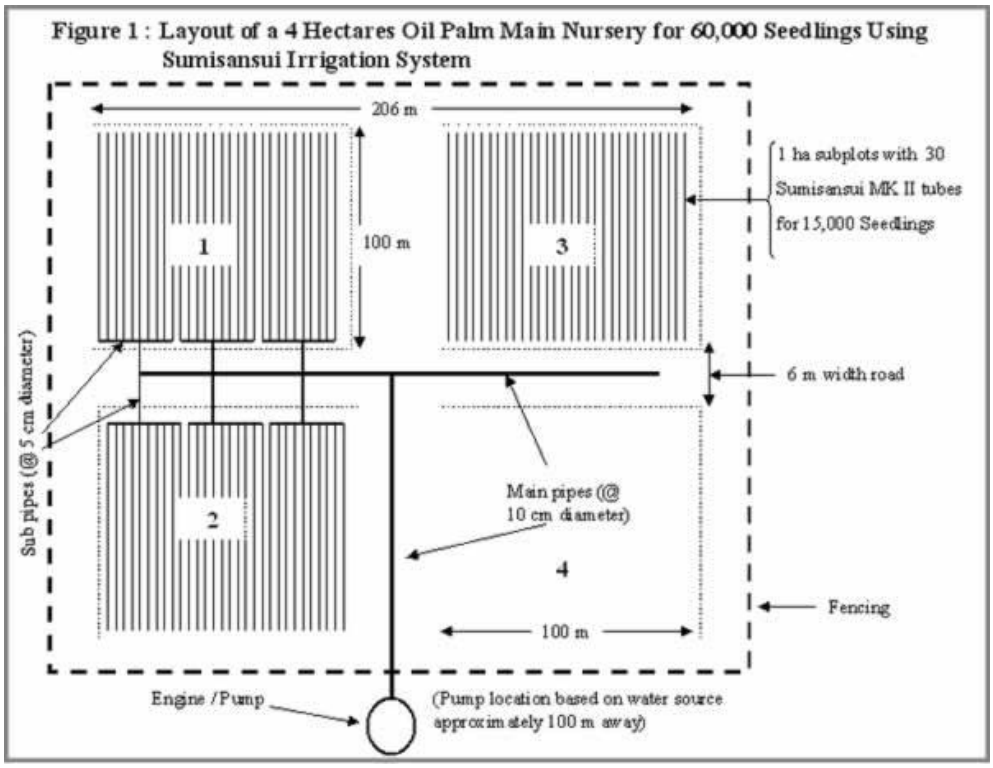
B. Site Preparation

The preparation of the area for a nursery is important to allow optimum seedling growth, maintenance of nursery site, unimpeded access and to provide hygienic conditions for plant growth. Four main activities are involved in preparing a site for nursery, namely nursery design, clearing, fencing and lining.

Nursery Design

A well-designed nursery allows for access of many vehicles during evacuation of seedlings for field planting especially for large-scale plantings. This objective can be achieved through the drawing up of a plan to show all paths, roads and irrigation points. An example is shown in Figure 1.

Figure 1 : Layout of a 4 Hectares Oil Palm Main Nursery for 60,000 Seedlings Using Sumisansui Irrigation System



Clearing

With the boundaries determined, felling and clearing should be carried out at least 2 months before the arrival of the seeds. Once clearing is completed, proceed to fence the area, fill the polybags and install the irrigation system.

Fencing

The major types of fences utilised for nurseries are the conventional barbed wire fence and the electric fence.

The Conventional Fence

The specifications for the conventional fence depend on the species of animals that it is required to keep out. For example, a four-strand barbed wire fence, with wires spaced at 0.3, 0.6, 0.9 and 1.2 m from ground should be adequate to control cattle and goats.

Electric Fencing

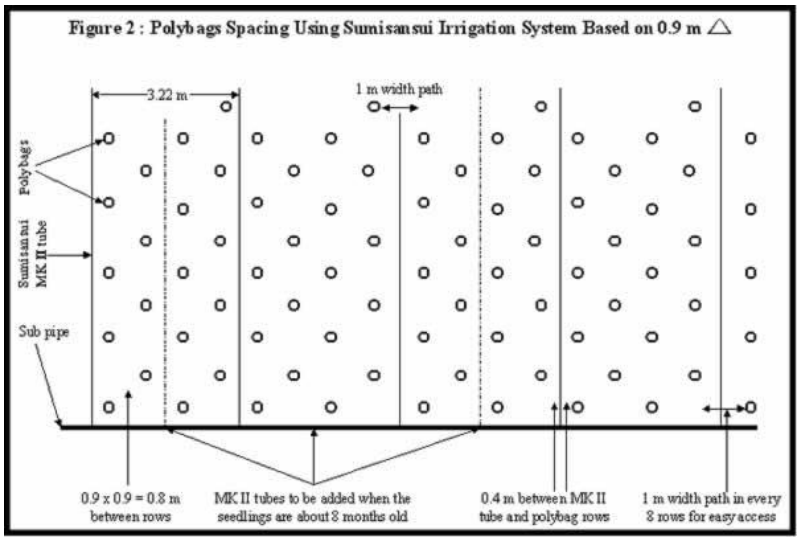
Where there is threat of wild mammalian pests, an electrical fence is possibly the best form of defence. Wires of 250-300 kg breaking strain have been found to be the most suitable. The heights at which the electrified wires are placed above ground level are critical, being dependent on the mammalian pests to be kept out, e.g. 10 cm to repel porcupines.

Lining

Lining is carried out to space the polybags evenly in the nursery, so that seedlings have good and uniform access to sunlight and to achieve the most cost effective irrigation system .

Polybags are lined at 0.91m (3 ft) x 0.91m (3 ft) triangular spacing to give each seedling the optimum growth space. All seedling rows must be straight along the axis at 60° to each other and parallel to irrigation lines.

In the Sumisansui irrigation system, MK II tubes are laid down between the polybags at every 4 rows, a 1 m wide path is provided at every 8 rows for easy access. When the seedlings are about 7 – 8 months old, additional MK II tubes are added between the existing MK II tubes to give a final layout of 1 tube for every 2-seedling row. This is illustrated in Figure 2.



Step by Step Guide to Establishing a Nursery

1. Planning

Planning a tree nursery includes working with the local community and other key people to determine the following:

- the purpose of your tree nursery
- location, ownership, permissions
- timescale
- resources and other inputs required
- species selection, technical advice
- end use of the trees

2. Resources: seeds, equipment

- Can you harvest sufficient seeds, seedlings or cuttings from the wild? What is the cost to purchase? Do you need to import?
- Equipment needed may include: containers, fertilisers, pesticides, helmets, hand gloves, hand trowels, wheelbarrow, watering cans as well as shovels, hoes, rakes etc.

3. Site preparation: soil, water/ irrigation, shade

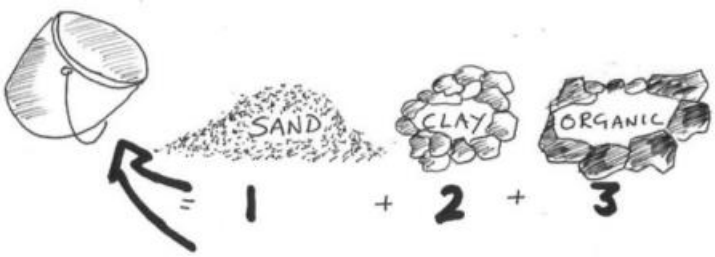
Good soil quality is essential for thriving trees. Not all trees need the same soil types.

Planting a variety of species over time, starting with nitrogen-fixing species such as the

Acacia tree, red-hot-poker tree, and turpentine tree, can improve the soil quality.

A typical soil for tree nurseries consists of:

- three parts organic / dark soil – such as dug from under existing vegetation
- two parts clay soil
- one part sand



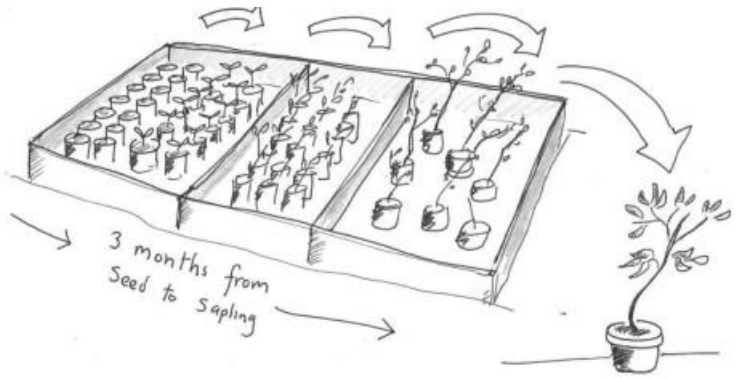
A typical soil quality test is to roll a small lump of soil in your hand. If it holds its shape when rolled, but snaps when bent, it should be suitable. Soil that crumbles contains too much sand. Soil that doesn't easily break contains too much clay.

Soil quality can be improved by adding one part manure or compost to every three parts of the mixed soil.

Seedbed preparation

 Seedbeds are usually constructed on top of the existing ground level. This reduces the amount of work involved and makes them more accessible to work on (watering, weeding, pruning and transplanting).

 Seedbeds are ideally located on a gentle slope to improve water retention, and narrow enough (approximately one metre) to make it easy to maintain the seedlings.



 The seedbed can be any length.

 Dig a shallow trough around the edges of the seedbed and fill these with material such as timber, brick, or stones to form the four supporting sides of the bed. The height of the sides should be at least 15cm. They can be any height above this, but a higher bed will require more soil within it.

 A shallow layer of small stones can be placed across the bottom of the bed to provide drainage.

 A layer of prepared soil is placed on top of the stones. This can be as shallow as five –10 centimetres.

4. Seeds or cuttings?

Most trees can be established from seed or from cuttings. However, seeds can be hard to come by and take more time and resources to protect and nurture. Consult your local agricultural authority or local farmers for advice. However, it's important that you do not establish all of your trees from cuttings from the same tree or its descendant. If all cuttings originate from the same tree, they are clones, which means that, if one is hit by disease or pest, the problem will very easily spread to all the others.

Taking cuttings

Cuttings are normally taken when seeds are not easily available.

 Examine the tree to ensure it is healthy.

 Cuttings should be side branches, not from the crown of the tree.

 Cut branches should have at least two bud scars, preferably three or four.

 Remove the leaves.

 The branch should be cut at 45 degrees.

 Cut 10–20cm lengths from smaller trees and 20–45cm lengths from large trees.

 Put the cutting in water for a few minutes, and then place it into a pre-made hole in a plant pot or seedbed.

 Space your cuttings evenly, maximum four to a 40cm-wide pot.

 Press the soil around the cuttings to ensure there are no pockets of air and lightly water them.

 Provide shade so the cuttings are not in direct sunlight.

 Gently water the cuttings every other day or when the soil is dry to touch. Do not overwater or the roots will rot.

 Don't disturb the soil around them as this will damage or kill them.

 Smaller trees normally grow new leaves and shoots after about a month.

 Keep watering and feeding the saplings for about three months, until they have plenty

of leaves, before transplanting them. Sowing seeds

 Large seeds should be sown in drills (lines) running across the seedbeds, about 5–10 cm apart.

 Smaller seeds can be scattered over the seedbed and pressed into the soil, for example with a piece of wood.

 Very small seeds should be first mixed with fine sand or soil before sowing to help space them out.

 When sown, spread a thin layer of fine soil (or sand) to about 5mm depth.

 Water regularly, up to twice a day if it is hot dry weather, but be careful not to overwater or the seeds will rot.

5. Potting

 Seedlings should be transferred to pots to avoid them choking each other. Do this when they have several mature leaves.

 Pots can be made of any local material, including polythene bags.

 Transplanting damages the roots, so is best done at the start or end of the day to avoid wilting.

 The seedlings should be well watered before transplanting.

 Prepare the pots by filling with soil and make a hole with a stick in the middle, to the same depth as the seedling roots.

 Insert a trowel or stick well underneath seedlings to lift them. Never pull them by the

stem. Place them in water if you cannot pot straight away.

 Gently place seedlings in the hole and press soil around them to remove any air pockets.

 Water immediately and place the potted seedlings together in a shaded area.

6. Care of seedlings

Seedlings should be cared for, including the following measures:

 Provide shade and shelter from the sun, wind and heavy rain.

 Avoid overcrowding which would limit growth due to lack of nutrients and water.

 Water regularly to protect seedlings from wilting.

 Prune any roots escaping from the pots to protect them from breaking when planted out.

 Weed regularly to avoid competition for nutrients.

 Fence off to prevent damage from grazing animals or theft.

Forest Trees

List of common trees for forest restoration in Sierra Leone

1	**Anacardium occidentale L.** (Anacardiaceae) cashew (en), nwa o pom (ht) Not native to Sierra Leone *Morphology:* Leaves alternate. Petiole short. In older seedlings, secondary veins almost perpendicular to midrib. Leaf sometimes reddish.	ANACOCCI		
2	**Annona muricata L.** (Annonaceae) soursop (en), korosol (ht) Not native to Sierra Leone *Morphology:* Leaves alternate, elliptic, with glossy upper surface. Secondary veins not visible.	ANNOMURI		
3	**Artocarpus heterophyllus Lam.** (Moraceae) jackfruit (en), nangka (id) Not native to Sierra Leone *Morphology:* Leaves alternate, tough, bright green to dark green, **glabrous**. Margin **entire**. *Compare with*: ARTOALTA ARTOINTE	ARTOHETE		
4	**Azadirachta indica A.Juss** (Meliaceae) neem (in, en), dogoyaro (ng), nim (ht) Not native to Sierra Leone *Morphology:* Leaves alternate, imparipinnate. Leaflets 10 to 30, **serrate**.	AZADINDI		

5	**Caesalpinia pulcherrima** (Fabaceae) poinciana (en), pride of Barbados (en) Not native to Sierra Leone *Morphology*: Leaves alternate, bipinnate, with 7-10 leaflets per sub-rachis. *Compare with*: DELOREGI	CAES0001		
6	**Codiaeum variegatum (L.) A.Juss.** (Euphorbiaceae) variegated croton Not native to Sierra Leone *Morphology*: Leaves alternate; petioles thick, curved; leaves obovate, **veriegated**.	CODIVARI		
7	**Cola acuminata Schott & Endl.** (Malvaceae) kola nut (en) **Native** to Sierra Leone *Morphology*: Leave alternate. Petiole **long**, **kneed**. Leaves glabrous, **leathery** with **three basal veins**.	COLAACUM		
8	**Delonix regia (Boj. ex Hook.) Raf.** (Fabaceae) flamboyant (en), flame of the forest (en), flame tree (en) Not native to Sierra Leone *Morphology*: Young plants: leaves pinnate with 5-12 pairs of leaflets. Leaflets wide oblong to slightly obovate, apex rounded, rarely with slight notch at apex. Older plants: bipinnate with tens of pairs of sub-rachis, and tens of pairs of leaflets per sub rachis.	DELOREGI		
9	**Gliricidia sepium (Jacq.) Steud.** (Fabaceae) gliricidia (en), piyon (ht) Not native to Sierra Leone *Morphology*: Leaves alternate, imparipinnate. Leaflets elliptical, entire. Secondary veins obscure.	GLIRSEPI		
10	**Gmelina arborea Roxb.** (Lamiaceae) gmelina (en), yemani (sl) Not native to Sierra Leone *Morphology*: Leaves opposite, broadly **ovate**, deeply **serrate** in seedlings, entier in adults.	GMELARBO		
11	**Mangifera indica L.** (Anacardiaceae) mango (en, ht) Not native to Sierra Leone *Morphology*: Leaves alternate. Petiole long. Leaves long, leathery, with secondary veins almost perpendicular to the midrib. Compare with cashew.	MANGINDI		
12	**Monoon longifolium Sonn. B.Xue & R.M.K.Saunders** (Annonaceae) false ashoka (en) Not native to Sierra Leone *Morphology*: Leaves alternate, lanceolate, leathery. Margin often **wavy**.	POLYLONG		

13	**Moringa oleifera Lam.** (Moringaceae) doliv (ht), moringa (en) Not native to Sierra Leone *Morphology*: Leaves alternate, **bipinnate**. Leaflets oval.	MORIOLEI		
14	**Piliostigma thonningii (Schum.) Milne-Redh.** (Fabaceae) camel's foot (en) **Native** to Sierra Leone *Morphology*: Leaves alternate, simple. Leaf apex **deeply cleft**.	PILITHON		
15	**Pithecellobium dulce (Roxb.) Benth.** (Fabaceae) guamúchil (mx) Not native to Sierra Leone *Morphology*: Leaves alternate, **bijugate** (paripinnate with one pair of leflets). Twig with thorns.	PITHDULC		
16	**Senna siamea (Lam.) Irwin et Barneby** (Fabaceae) siamese cassia, kassod (en), (a)kasya (ht) Not native to Sierra Leone *Morphology*: Leaves alternate, **paripinnate**. Leaflets opposite, 6-16, elliptic. Secondary veins obscure. Leaflets similar to GLIRSEPI, but leaf without a terminal leaflet.	SENNSIAM		
17	**Tamarindus indica L.** (Fabaceae) tamarind (en), tamren (ht), tombi (sl) *Morphology*: Leaves alternate, **paripinnate**. Leaflets opposite on rachis, in 7-8 pairs, oblong in shape.	TAMAINDI		
18	**Tectona grandis L.f.** (Lamiaceae) teak (en) Not native to Sierra Leone *Morphology*: Leaves **opposite, large, obovate, almost sessile**.	TECTGRAN		
19	**Terminalia ivorensis A.Chev.** (Combretaceae) ronko (sl), bagyi (sl), idigbo (en) **Native** to Sierra Leone	TERMIVOR		

PARTICIPATORY QUIZ

1. What do you understand by forest conservation and why is it important?
2. Please explain how to set up a forest nursery.

REFERENCES FOR MORE READING

https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services

https://www.fao.org/faolex/results/details/en/c/LEX-FAOC005732/

https://www.fao.org/faolex/results/details/en/c/LEX-FAOC150279/

https://forestrypedia.com/nursery-importance-and-types/

https://learn.tearfund.org/-/media/learn/resources/series/reveal/c2---establishing-a-tree-nursery.pdf

https://herbarium.treetracker.org/guide/guide_sl.html