Natural Resources Conservation and Development III

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Module Title: Monitoring Agro-forestry Practices LG

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L #47	LO #1 Identify the agro-forestry technologies, packages or practices

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Assessing and identifying technology requirment
- Analyzing agro-forestry package
- Working out cost benefit analysis of the package
- Identifying relevant solutions and setting priorities

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Assess and identify technology requirment
- Analyze agro-forestry package
- Work out cost benefit analysis of the package
- Identify relevant solutions and set priorities

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1. Assessing and identifying technology requirment

1.1. Introduction

Definition and concept

Agroforestry is a collective name for land-use systems and technologies, where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land management unit as agricultural crops and or animals, either in some form of spatial arrangement or temporal sequence. It also defined as a dynamic, ecologically based natural resource management system that, through the integration of trees on farms and in agricultural landscapes or through the production of agricultural products in forests, diversifies and sustains production for increased economic, social and environmental benefits for land users.

Agroforestry is a common land use system worldwide and a great variety of systems and practices exist under different climatic conditions, from tropical to hyper-arid areas. More recently, the term agroforestry has come to include the role of trees in landscape-level interactions, such as nutrient flows from forest to farm or community reliance on fuel, timber or biomass available within an agricultural landscape.

1.2. Assessing and identifying technology requirement

Agroforestry can be advantageous over conventional agricultural and forest production methods. They can offer increased productivity as well as greater diversity in the ecological goods and services provided.

There are three major aspects from which agroforestry technologies define:

1. Bio-physical aspect
2. Socioeconomic aspect
3. Environmental and cultural aspect

1. Bio-physical aspect

Agroforestry systems enhances crop lands in diverse ways by significantly contributing to soil organic renewal, maintenance of soil nutrients, soil erosion control, minimize soil nutrient leaching as well as improve the soil recycling potentials for increase agricultural productivity.

In addition to soil conservation and fertility enhancement agroforestry technologies can also enhance plant diversity while reducing habitat loss and fragmentation. Adoption of agroforestry can lead to an improved crop and livestock production because agro-

forestry practices are less costly, more affordable since inputs for fodder and soil amendments are readily available to small holder farmers.

However, technology transfer and adoption have some challenges due to several existing factors like:

- In-adequate credit facilities
- Non-availability of farm inputs and
- Socio-cultural factors as contributing factors to low levels of adoption.

2. Socio-economic aspect

The integration of different tree species with herbaceous crops on agricultural fields comes with great socioeconomic benefits to farmers and farming families. The products of agroforestry such as timber, fuel wood, fruits, herbs and honey serves as an additional income generating potential for farmers.

Increasing of production, productivity and product diversity through agroforestry can help improve the income, health and nutrition of the adopter through:

- Creating opportunities for small-scale forest-based enterprises
- Reduce rural poverty by increasing on-farm production and household income
- Providing employment opportunities
- Ensure food security
- Control poverty
- Improve production capacity of soil
- Reduce deforestation and pressure of forest and empower female farmers and other under privilege rural dweller

3. Environmental aspect

Any economic assessment of agroforestry enterprises should carefully consider the important indirect effects, such as erosion control and watershed maintenance, on the economic and social welfare of people both inside and outside the project boundary. This inclusion is critical; from society's viewpoint these environmental benefits can be key factors in the decision to promote agroforestry.

Agroforestry systems can provide a range of environmental services. It works towards land protection and conservation through more effective protection of stock, control of soil erosion, salinity and water tables and a higher quality control of timber.

Agroforestry technology can improve:

- Improve soil fertility
- Protect crops and livestock from wind
- Restore degraded lands
- Improve water conservation
- Prevent soil erosion etc.

In the case of soil conservation, benefits can be ascertained through the market value of the sustained or increased crop production made possible by an agroforestry intervention.

1.3. Attributes/role of agroforestry

The term is used to denote practices ranging from simple forms of shifting cultivation to complex hedgerow intercropping systems; systems including varying densities of tree stands ranging from widely-scattered Faidherbia (Acacia) albida trees in fields, to the high-density multistoried home gardens of the humid tropics; and systems in which trees play a predominantly service role (e.g., windbreaks) to those in which they provide the main commercial product (e.g., intercropping with plantation crops). It needs to be reemphasized that one concept is common to all these diverse agroforestry systems: the purposeful growing or deliberate retention of trees with crops and/or animals in interacting combinations for multiple products or benefits from the same management unit. This is the essence of agroforestry.

Additionally, there are three attributes which, theoretically, all agroforestry systems possess. These are:

1. Productivity: Most, if not all, agroforestry systems aim to maintain or increase production (of preferred commodities) as well as productivity (of the land). Agroforestry can improve productivity in many different ways, Include: increased output of tree products, improved yields of associated crops, reduction of cropping system inputs and increased labor efficiency.

2. Sustainability: By conserving the production potential of the resource base, mainly through the beneficial effects of woody perennials on soils.

3. Adoptability: The word "adopt" here means "accept," and it may be distinguished from another commonly-used word adapt, which implies "modify"

or “change." The fact that agroforestry is a relatively new word for an old set of practices means that, in some cases, agroforestry has already been accepted by the farming community. However, the implication here is that improved or new agroforestry technologies that are introduced into new areas should also conform to local farming practices.

1.4. Agroforestry practice/technologies

Agroforestry practice are all practices that involved a close association of trees or shrubs with crops, animals and/ pasture. There are different types of agroforestry practices which have been found to address specific human and environmental needs. Some agroforestry practices/technologies used worldwide are described in the table below.

I. Agrisilvicultural systems (crops - including shrub/vine/tree crops - and trees)

- Improved fallow
- Taungya
- Alley cropping (hedge-row intercropping)
- Multilayer tree gardens
- Plantation crop combinations
- Multipurpose trees on crop lands
- Home gardens
- Trees in soil conservation and reclamation
- Shelterbelts and windbreaks, live hedges

II. Silvopastoral systems (trees + pasture and/or animals)

- Trees on rangeland or pastures
- Protein banks
- Plantation crop with pasture and animals

III. Agrosilvopastoral systems (trees + crops + pasture/animals)

- Home garden involving animals
- Multipurpose woody
- Hedgerows
- Apiculture with trees

- Multipurpose woodlots
- Aqua forestry

Some agroforestry practice/technologies are discussed below.

Home garden (small mixed species with intensive management): Home gardens are one of the most diverse agroforestry systems and make a vital contribution to meet various household needs, especially for smallholder farmers.

In home gardens, commonly farmers plant fruit trees as:

- Middle-level perennial crops like bananas and papayas
- Shorter perennials like pigeon peas
- Annual crops and medicinal plants.
- Annual crops and medicinal plants.

Crops and animals as well as wood perennials are well integrated in this system to derive maximum benefit among them. However, it exists with or without animals. Home gardens as an agroforestry technology practice is important for women participation involving the cultivation of vegetables, medicinal trees, shrubs, fodder and retention of some naturally occurring trees on a relatively small piece of land that are close to people's houses. Benefits derived from this form of practice is enormous and farmers engage in this on the same piece of land for an extended period of time

Figure1 Home garden agroforestry practice

Alley cropping: Alley cropping is an agroforestry practice intended to place trees within agricultural cropland systems. The purpose is to enhance or add income diversity (both

long and short range), reduce wind and water erosion, improve crop production, improve utilization of nutrients, improve wildlife habitat or aesthetics, and/or convert cropland to forest. The practice is especially attractive to landowners wishing to add economic stability to their farming system while protecting soil from erosion, water from contamination, and improving wildlife habitat.

Alley cropping is broadly defined as the planting of rows of trees and/or shrubs (single or multiple) at wide spacing, creating alleyways within which agricultural crops or horticultural crops are produced. The trees may include valuable hardwood veneer or lumber species, nut or other specialty crop trees/shrubs, or desirable softwood species for wood fiber production. It is an agroforestry technology which comprises of planting of trees in rows at extensive spacing with crops grown in between the rows.

Benefit: It has potential of income diversification, improve crop production and provide protection and conservational benefits to crops.

- Improved economic stability
- Increased cash flow
- Improved plant/animal diversity
- Sustainable agricultural systems
- Improved aesthetics

Alley farming is the planting of trees in widely spaced rows, allowing annual crops to be grown between the rows. Good tree species for this are ones that produce something useful, such as fruit, nuts, fodder, fuelwood, green manure, construction poles, or roofing fronds. The tree rows may also anchor soil and increase the amount of rainwater soaking into the cropped area.

Annual crops can also be cropped between rows of tree seedlings when establishing orchards and plantations, until the tree canopy closes. Usually the canopy closes after two to five years. Alley-cropped trees planted for fodder, firewood, or green manure need to be periodically pruned at about shoulder level (pollarding). Pollarding at the beginning of a rainy season cropping cycle will:

- Maximize the sunlight getting to crops between the rows
- Provide foliage as green manure

- Send the trees into recovery shock and reduce the amount that their roots compete with crops.

Some crops, like coffee, grow best with shade trees. Shade trees also have ecological aspects such as bird habitat. Low-shade trees like coconut palms can be grown above annual crops. In an alley cropping practice an agricultural crop is grown simultaneously with a long- term tree crop to provide annual income while the tree crop matures. Fine hardwoods like walnut, oak, ash, and pecan is favored species and can potentially provide high- value lumber or veneer logs.

Figure2 Alley cropping technology

Tree Arrangement

Alley cropping is unique compared to traditional agriculture or traditional forestry because, through the interaction of trees and crops, the goal is to maximize the economic gain based on the combination of the two. Alley cropping practices are highly diverse and range from simple to complex. When deciding the best tree arrangement, consider:

• The growth characteristics of potential tree species

• Whether single or multiple rows should be planted

• Whether single or mixed species should be used

• What the spacing should be both within the tree rows and between the rows

• Light requirements of companion crops

Species tree most selected are Black Walnut, Pecan, Chestnut, Ash, Oak, Pine, Poplar, Nut/Fruit Shrubs, and Paulownia etc.

Taungya system: Taungya is a system originating in Burma. The taungya system was used primarily as an inexpensive means of establishing timber plantations but is finally a recognized AF system. The taungya (taung = hill, ya = cultivation) is a Burmese word coined in Burma in 1850. The system was introduced to India by Brandis in 1890 and the first taungya plantations were raised in 1896 in North Bengal. In the initial stages of an orchard or tree plantation, trees are small and widely spaced. The free space between the newly planted trees accommodates a seasonal crop.

This is a modified form of shifting cultivation in which the labor is permitted to raise agri-crops in an area but only side by side with the forest species planted by it. The practice consists of land preparation, tree planting, growing agricultural crops for 1-3 years, until shade becomes too dense, and then moving on to repeat the cycle in a different area.

This system was introduced to raise forest plantations, but finally became recognized agroforestry system. Cultivation is often allowed to continue until trees shade crops due to canopy closure. Taungya farming is a special arrangement between the forestry department and farmers, which combines the production of both arable and forest tree cops simultaneously on a piece of land.

Types of Taungya

i. Departmental Taungya: Under this, agricultural crops and plantation are raised by the forest department by employing a number of laborers on daily wages. The main aim of raising crops along with the plantation is to keep down weed growth.

ii. Leased Taungya: The plantation land is given on lease to the person who offers the highest money for raising crops for a specified number of years and ensures care of tree plantation.

iii. Village Taungya: This is the most successful of the three taungya systems. In this crops are raised by the people who have settled down in a village inside the forest for this purpose. Some plant species selected for this purpose are *horea robusta, Tectona grandis*

Acacia catechu, Dalbergia sisso, Eucalyptus spp. Populus spp. Anacardium occidentale, Tectona grandis, Bombax ceiba, Bamboo, Eucalyptus spp.

Advantages of Taungya:

- Artificial regeneration of the forest is obtained cheaply;
- Problems of unemployment are solved;
- Helps towards maximum utilization of the site;
- Low cost method of forest plantation establishment;
- In every case, highly remunerative to the forest departments;
- Provision of food crops from forest land; and
- Weed, climber growth, etc. is eliminated.

Woodlot establishment: If an area is set aside more or less entirely for trees, such an arrangement is known as a woodlot. It is a plot of planted or naturally growing trees. They provide multiple products and services such as timber, poles, fuelwood, medicine, soil-erosion control and shelter. Vegetables or crops are often intercropped in the woodlot in the early stages of establishment, but with time wood production is the most important use. In small-scale farming areas woodlots are often very small, 0.1 hectare or less. Large-scale farms may have woodlots of many hectares. *Examples of species* Fast-growing and coppicing species are best, e.g. *Eucalyptus* spp., *Acacia mearnsii, Markhamia lutea* and *Cassia siamea.* Pinus patula can also be used although it hardly coppices. *Cupressus lusitanica* has been used, but due to problems with the cypress aphid it should not be encouraged as much. *Casuarina* spp. may be alternatives.

Diversifying woodlot with timber enhances overall income through,

- Short term (food crops)
- Medium term (fuelwood)
- Long term (timber)

Figure 3 Woodlot and its products

Fodder banks: Fodder banks are plots of fast-growing and high-yielding trees, grasses and shrubs managed for fodder production. The animals are given supplements of protein-rich feedstuffs during the dry season when other good-quality fodder is scarce. The fodder may be cut, carried and fed to livestock in their enclosure. Alternatively, livestock can be allowed to graze on the fodder bank, although not all fodder species tolerate this well.

Plants that would be suitable for fodder should be:

- Palatable to livestock and rich in protein
- Easy to manage
- Drought tolerant

The goal of fodder banks is to maintain healthy productive animals. They can be utilized all year, but are designed to bridge the forage scarcity of annual dry seasons. Fodder banks do not provide 100% of feed requirements, but supplement the available dry-season forage. Specieies most selected for this technology are: *Albizia lebbeck, Cajanus cajan, Sesbania, Calliandra tetragona, Desmodium spp., Erythrina bertcroana, Sesbaniaa sesban, Leucena diversifoli, Erythrina edulis.*

Tree intercropping: Intercropping is farming practices involve two or more crop species growing together and coexisting for a time. On the fringes of modern intensive agriculture, intercropping is important in many subsistence or low input/resource-limited agricultural systems.

Benefits of mixing crop with trees can:

- Increased and diversified production
- Reduced lodging of vulnerable crops to wind
- Structural support to creeping plants
- Suppressed weeds and increased nutrients
- Shade for light-sensitive plants.

Figure 4 Tree intercropping

Hedgerow: A hedge or hedgerow is a line of closely spaced shrubs and sometimes trees, planted and trained to form a barrier or to mark the boundary of an area, such as between neighboring properties.

Hedgerows can have money benefit. Among their many benefits, hedgerows:

- Enhance ecological biodiversity.
- Offer food for livestock, humans and wildlife.
- Provide habitat for beneficial insects and pollinators.
- Facilitate water conservation.
- Provide windbreaks.
- Help manage invasive weeds.
- Provide erosion control and improve soil health.
- Support the health of aquatic habitats.
- Enhance carbon sequestration.

- Create borders and privacy screens.
- Reduce noise, dust, chemical drift and other types of pollution.
- Diversify farm income.
- Generate year-round beauty.

Figure 5 Contour vegetation hedgerows

Hedges are recognized as part of a cultural heritage and historical record and for their great value to wildlife and the landscape. Increasingly, they are valued too for the major role they have to play in preventing soil loss and reducing pollution, and for their potential to regulate water supply and to reduce flooding. There is increased earthworm diversity in the soils under hedgerows which also help to store organic carbon and support distinct communities of arbuscular mycorrhizal (AM) fungi.

In addition to maintaining the health of the environment, hedgerows also play a huge role in providing shelter for smaller animals like birds and insects. The best hedges for wildlife are thick and broadest at the bottom with a range of woody species such as *hawthorn, blackthorn, field maple, hazel, spindle, wayfaring tree* and wild service tree occasionally overtopped by oak, ash and other standards (sometimes pollarded).

Ramblers such as bramble and rose are frequent, together with climbing honeysuckle and wild clematis. At the foot of the hedge, thick herbaceous vegetation commonly includes species such as cow parsley and hedge mustard with coarse grasses, although sometimes woodland flora is found with bluebells and greater stitchwort. Hedges provide song posts, shelter and nesting opportunities for both woodland and farmland birds such

as yellowhammer, whitethroat, blue tit and great tit, while nectar, berries, nuts and leaves provide food for an assortment of invertebrates, mammals and birds. In addition to providing excellent wildlife habitat, hedges can help reduce soil erosion and water run-off on arable land.

Live Fence: A Multipurpose Living Structure

Living fences are lines of trees or shrubs planted on farm boundaries or on the borders of home compounds, pastures, fields or animal enclosures. Living and live fences are the same thing -the two terms are used interchangeably. Living and live fences are the same thing -the two terms are used interchangeably. Live fences are barriers of closely spaced trees or shrubs to protect crops or structures against livestock and human interference.

- It may be established all around the farm, but it is commonly established around the homesteads and gardens.
- It is commonly practiced in Ethiopia. Live fences can be combined with other trees for production of wood and fruits.
- They can be made of single or multiple densely planted rows.
- Alternatively, one row of living fence posts can be planted widely spaced, with wire, sticks or dead branches between the trees.
- The use of live fences is a cheap method of fencing large areas because once the live fences become established they are permanent.
- Their establishment requires no expensive materials to be purchased and they are easy to maintain.
- Living fences may also give produce, e.g. fruits.

Purpose and Function

Their primary purpose is to control the movement of animals or people. Beside their main function - to control human and animal movement - live fences may provide fuelwood, fodder and food, act as wind breaks, enrich the soil, provide bee forage, provide shade and control dust. Live fences tend to be considerably less expensive than fences made of purchased materials, such as wood, metal or stone.

Establishing and maintaining a live fence

It is important that the young live fence tree/shrub be protected with temporary man-made structures for at least during the first few years until they are tall and thick enough to withstand browsing livestock and to serve their barrier function. Once the live fence is established, the temporary manmade structure, as for example barbed wire fence, can be reutilized to establish another live fence.

As the trees and shrubs grow, they must be pruned, usually on an annual basis. Otherwise, they may take up too much space or cast too much shade on adjacent crops. Living fences should not compete with adjacent crops or pasture grasses: species with competitive rooting systems, which are aggressive, sprouting or self-seeding or which produce growth-inhibiting chemical substances or toxins, should be avoided.

Many different tree species are used for live fence, depending on the ecological zone, availability of stock and the specific needs of farmers. The most common useful species in Nepal are Tanki (bauhinia purpuria), Sisoo (dalbergia sisoo), Ml Kanda, different species of cactus etc. Ipil-Ipil was planted extensively in farms and live fences during the last decades, but due to severe attack by psyllid (a tiny insect), its extensive planting is reduced.

Improved fallows: An improved fallow is a piece of land planted with, preferably fast-growing, and nitrogen fixing species of trees/shrubs for the purpose of enhancing soil fertility.

Benefits

- Protect the soil from erosion.
- Reduction of nuisance weeds
- Increase the nutrient and organic-matter content of the soil by improving its fertility and structure, including aeration, water-holding capacity and tilth.
- Production of fuelwood.

Windbreaks: A windbreak (shelterbelt) is a planting usually made up of one or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion. They are commonly planted in hedgerows around the edges of fields on farms.

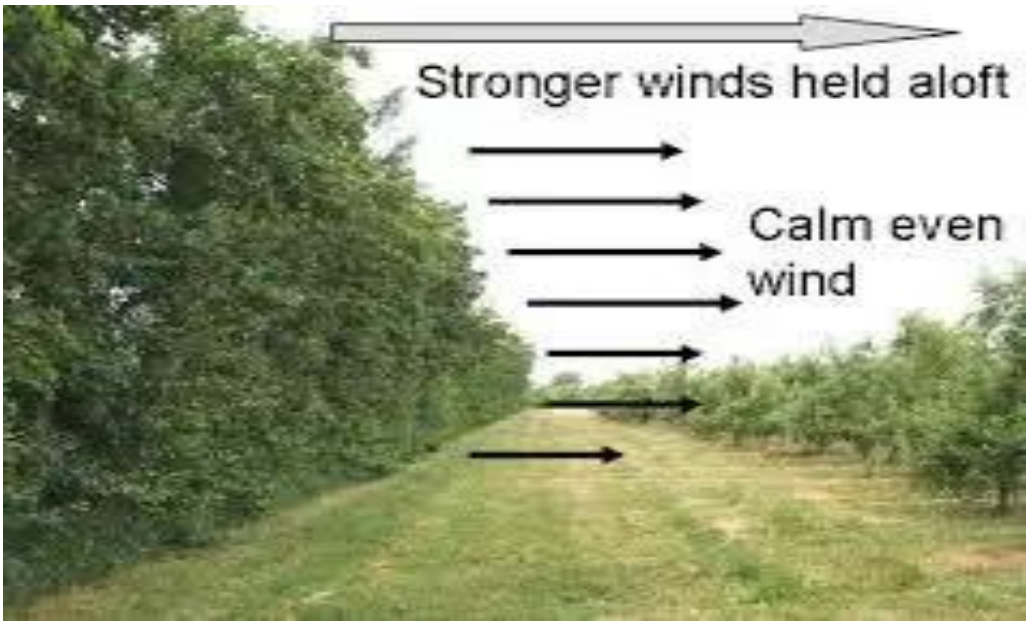

Figure 6 Wind break

1.5. Criteria of classifying agroforestry

The most obvious and easy-to-use criteria for classifying agroforestry systems are the spatial and temporal arrangement of components, the importance and role of components, the production aims or outputs from the system, and the social and economic features. They correspond to the systems' structure, function (output), socioeconomic nature, or ecological (environmental) spread. These characteristics also represent the main purpose of a classification scheme. Therefore agroforestry systems can be categorized according to these sets of criteria:

Structural basis: This refers to the composition of the components, including spatial arrangement of the woody component, vertical stratification of all the components, and temporal arrangement of the different components.

Functional basis: It refers to the major function or role of the system, usually furnished by the woody components (these can be of a service or protective nature, e.g., windbreak, shelterbelt, soil conservation).

Socioeconomic basis: refers to the level of inputs of management (low input, high input) or intensity or scale of management and commercial goals (subsistence, commercial, intermediate).

Ecological basis: refers to the environmental condition and ecological suitability of systems, based on the assumption that certain types of systems can be more

appropriate for certain ecological conditions; i.e., there can be separate sets of agroforestry systems for arid and semiarid lands, tropical highlands, lowland humid tropics, etc.

Self-check 1	Written test

Test I: Choose the best answer (2 point)

1. From the following one is the major attribute of agroforestry technology?

A. Productivity B. Sustainability

C. Adoptability D. All

2. Which one is potential benefit of alley cropping?

A. Income diversification B. Improve crop production

C. Provide protection and conservational benefits to crop D. All

Test II: Short Answer Questions

1. List some agroforestry practice/ technologies (3points).
2. List the three major aspects that consider in agroforestry practice (3 point)
3. Write trees characteristics that would be suitable for fodder (4 point)
4. List the role of agroforestry for socio-economic benefits (3 points)

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

Information sheet 2. Analyzing agro-forestry package

2.1. Agro-forestry package

Agroforestry package a desire to use market mechanisms to improve socio economic and environmental credentials of current farming methods. It is used to improve the environmental credentials of intensive arable farming whilst maintaining productivity by converting to agroforestry systems.

Agroforestry practice/ technology package include activities such as:

2.1.1. Site preparation/land

After the site is selected and prepared the next step to implement is to collect or buy the seed of the desired tree species to be planted. When fruit is ripe, collect seeds from at least 30 mature, healthy, vigorous trees. Store seeds in a cool, dry place to avoid loss of viability. Remember that some seeds can be stored for much longer than others and some cannot be stored at all.

2.1.2. Seed collection and handling activities

These activities are including:

- Selection of seed provenance
- Selection of mother trees
- Seed collection
- Seed extraction
- Seed storage
- Record keeping
- Pre-sowing treatment

2.1.3. Tree Propagation

Methods of tree propagation

- Direct seed sowing in the field
- Collection of wildings
- Raising seedlings
- Cuttings
- Budding and grafting

2.1.4. Management of trees in the Field

- Planting
- Fertilizer application
- Weeding
- Protection of young plant
- Control of pests and diseases in plants

2.1.5. Tree Management activities

Agroforestry operations management activities may also be applied to reduce negative effects of the presence of trees and shrubs, such as the shading effect on adjacent crops.

The most common forest operation practices/activities included under agroforestry package are:

- Pruning
- Pollarding
- Coppicing
- Lopping
- Thinning
- Wedding and
- Clearing **etc.**

A. Punning: Pruning is a silvicultural practice involving the selective removal of certain parts of tree plant, such as branches or roots. Reasons to prune plants include deadwood removal, shaping (controlling growth), improving or sustaining health, reducing risk from falling branches, preparing nursery specimens for transplanting, and both harvesting and increasing the yield or quality of trees.

Types of tree pruning

I. Crown lifting: Crown lifting involves removing the lower branches in the crown.

This is often done to provide clearance, over paths or roads for example, or sometimes to allow more light to pass beneath the crown.

II. Crown thinning: Crown thinning involves the selective removal of branches throughout the crown, such that the overall shape of the crown is not significantly changed.

Crown thinning increases light penetration and air circulation throughout the crown.

III. Crown reduction: Crown reduction is the reduction in overall size of the crown by shortening branches, cutting back to a suitable growth point.

Crown reduction is usually used where a tree has outgrown the space it stands in.

B. Pollarding: Pollarding is cutting off the top and branches of (a tree) to encourage new growth at the top. Pollarding activities of cutting tree back nearly to the trunk so as to produce a dense mass of branches. Traditionally, the cut branches were fed to livestock (fodder), burned as fuel, or used to make things. It is one of the management that deals with cutting of trees at a height of 2m from the ground. The height helps in protecting the young emerging shoots from the damage of animals.

Figure 7 Pollarding

C. Coppicing: Coppicing is cutting down of the whole stem/shoot of the tree from the ground level in order to get artificial regeneration and one or two coppices (small sapling) are left for regeneration in future. It is an ancient form of woodland management that involves repetitive felling on the same stump, near to ground level, and allowing the shoots to regrow from that main stump. (Also known as the coppice stool)

Most frequently coppiced species are eucalyptus spp, oak, hazel, ash, willow, field maple and sweet chestnut.

Figure 8 Coppice o willow tree

D. Lopping: Is the application of partial or fully removal of branches for the purpose of fuel wood, fodder production or mulching. Prior to the application of this management practice, one should properly know the response of the species for the practice.

E. Thinning: Thinning is the selective removal of trees. It's primarily undertaken to improve the growth rate and health of the remaining trees. Thinning allows more light into the forest and reduces competition for the remaining individuals, thus enhancing development.

There are two main types of thinning:

I. Selective thinning: Where damaged, suppressed or dead trees are individually removed.

II. Systematic thinning: Where predetermined areas such as entire rows are removed, e.g. one row in three is removed.

Particularly, young trees grow fast and are more likely to survive if properly weeded and, if necessary, thinned. While under taking all these operation techniques monitoring and reviewing the activities are essential steps in forestry works.

F. Cleaning and weeding: Cleaning and weeding are seems two similar terms referring to the practice of selecting particularly desirable trees in a young stand and removing or killing trees that threaten their survival or development.

But used correctly, the term cleaning refers to the removal or killing of over topping competitors that are significantly taller than the desired trees, and is usually done in the sapling stage, while the term weeding refers to the removal of mainly herbaceous

plants and shrubs that are of the same height, but still competing for the resources that could be used by the selected trees. It is usually done in the seedling stage.

Self-check 2	Written test

Test I: Choose the best answer (2 point)

1. From the following which one is primarily objective of tree thinning?

A. To improve the growth rate of trees

B. To keeps the health of the remaining trees.

C. A and B D. None

2. One is type of tree pruning used to remove the lower branches in the crown

A. Crown lifting B. Crown thinning C. Crown reduction D. All

Test II: Short Answer Questions

1. List agroforestry practice/ technological packages (3points).
2. Write tree management activities in agroforestry practice(3 point)

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Information sheet 3. Working out cost benefit analysis of the package

A cost-benefit analysis (CBA) is the process used to measure the benefits of a decision or taking action minus the costs associated with taking that action. A CBA involves measurable financial metrics such as revenue earned or costs saved as a result of the decision to pursue a project. The mean crop or wood harvested either by pruning or by clear felling or through sale of corn or trees per farmers on an average per year is calculated.

First, given that the costs of hired labor for planting, pruning, weeding, and market transportation were by far the greatest enterprise expenses in agroforestry. The financial success of this labor-intensive operation was to a large extent dependent on pricing farm-family labor at zero. An economic analysis of this system would have instead utilized the opportunity cost of on-farm family labor in alternative employment as a more appropriate family wage rate. The zero wage rates for family members actually used suggested that off-farm employment opportunities were for all practical purposes, nonexistent and that no other valuable on-farm activities would be displaced.

Secondly, an economic analysis would have incorporated the price for the production and transportation of seedlings as a cost of this agroforestry intervention to be borne by society. Furthermore, the analysis did not include any cost figure for the land to be allotted to the proposed undertaking. The value of the contribution of land in foregone alternative agricultural enterprises (the opportunity cost), depending on the specific physical and demographic setting, could be much greater than the zero figure utilized. In practice, costs are frequently considered as the constraint and a Benefit-Cost Ratio approach is used.

Cost: Costs and benefits do not always occur at one time; they occur at different points of time during the life of the project. In most cases, the lifetime worth, that is the lifetime aggregate of all the costs and benefits, taking into account the time of their occurrence, is used to compare different projects and to decide which alternative to choose.

To analyze costs benefit of agroforestry practice or package the following information is required:

A. Fixed cost

- Land

B. Recurrent cost

- Tools (cutlass, chisel, spraying machine, etc.)
- Planting materials i.e. tree seedlings, seeds of food intercrops planted in the first to take advantage of the soil rent on clearing of vegetation for tree establishment
- Herbicides and manual weed control
- Labor for land preparation, planting, maintenance and harvesting of wood
- Input cost for trees and crops including for raw material for shading and mulching nursery seedling are:
  - ✓ Straw.
  - ✓ Hay.
  - ✓ Fertilizers (organic fertilizer is more preferable)
  - ✓ Pesticides
  - ✓ Insecticides.
  - ✓ Tending
  - ✓ Harvesting etc.

Benefits: Total revenue was estimated from quantity of agroforestry practice per hectare * price per unit. If the system is producing an end item, such as a farm producing outputs/fruits/grains, then the revenue received by selling the produced items is the benefit obtained. If agroforestry practicing/package, producing potential income such as a commercialization of timber product, then it receives income by selling its product.

- Return from trees and crops
  - ✓ Incomes from corn yield
  - ✓ Wood yield by pruning, thinning etc
  - ✓ Fodder
  - ✓ Selling products as fruits, leaves, corns, and
  - ✓ Timber products.
  - ✓ Non timber product etc.

Self-check 3	Written test

Test I: Choose the best answer (2 point)

1. From the following which one has to be considered to analyses B/C.?

A. Input cost for trees and crops B. Return from trees and crops C. A and B

Test II: Short Answer Questions

1. Write input cost for trees and crops (3points).
2. List benefits/return from trees and crops (3 point)

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Information sheet 4. Identifying relevant solutions and setting priorities

4.1. Identifying relevant solutions

Agroforestry has come of age during the past fifteen years. During this period, activities and interest in agroforestry education and training have increased tremendously, as in other aspects of agroforestry development. Today agroforestry is taught at the senior undergraduate and postgraduate levels in many institutions around the world, either as a separate subject or as a part of the regular curricula of agriculture, forestry, ecology, and other related programs.

Agroforestry also helps maintain ecological balance through sequester of carbon and provides multiple benefits to the livelihood of farmers, and thus has a great potential to contribute to climate change mitigation; however its implementation have some constraint due to:

- Lack of Knowledge
- Lack of infrastructure
- Absence of forestry extension workers
- Lack of cost of production etc.

These challenge solved through:

- Awareness creation
- Training
- Introduce improved species
- Develop policy which advocates Agroforestry
- Experience sharing
- Market access
- Communication
- Participation of different stake holders
- Financing/budgeting

4.2. Setting priorities to choose tree species for agroforestry

Priority setting is not only an analytical process. It also tries to build the agreement and the consensus that the right decision has been made. Priority setting has to allow for

discussions because only by challenging the initial outcome, it is possible to improve the quality of the final decisions.

Thus the procedure for choosing a tree species for improvement has been divided into seven steps:

Step1. The first step is to build an effective team among the participants from the different institutions and to agree with them on the application of the priority setting approach and the modifications that may be required for the specific circumstances.

Step2. The second step concerns the assessment of client needs. MPT improvement should be directed towards satisfying the needs of the users and it is important that there is a shared understanding of who the clients and what their needs are;

Step3. The third step is to make an inventory of all the species that are being used by the clients. This inventory forms the universe from which the priority species will be selected. Exotic species that are presently not used in the region, but that may have potential can be added to the list;

Step4. The fourth step is to define the most important products that the MPTs provide in the target region. Only those species producing the products of great importance to the clients are considered in the priority setting process;

Step5. The fifth step is to select a limited number that have the highest expected benefits of research, as can be estimated through the data collected thus far;

Step6. In the sixth step, the value of production for these key species is estimated by means of primary data collected in a survey. This step provides the quantitative information needed to set priorities among the remaining species;

Step7. The final step is to synthesize previous results, to review the process and to approve the choice of the priority species.

Priority setting for agroforestry practice is severely constrained by the pour data availability. In consequence, a procedure has been developed which builds on widely and easily available information to make initial screenings and which gradually collects and develops more specific information about the technologies package to make the final decisions.

4.3. Tree species selection for agroforestry

Agroforestry encompasses a wide range and diverse set of practices ranging from trees on croplands to complex production forests. It has been known for its diversity, ecosystem balance, sustainability, household food security and rural development. Variety of woody species in agricultural systems supplies products and ecological services. Agroforestry practices including various forms of tree planting and indigenous practices exist and trees are planted on farms in different niches.

4.3.1. Desirable characteristics for agroforestry

While selecting tree species for agroforestry systems, the following desirable characteristics should be taken into consideration. Though all desirable characters are not found in a single species, but their multiple uses are taken care of.

- Tree species selected should not interfere with soil moisture
  - ✓ Tree species selected for agroforestry should have very less water requirement
  - ✓ Should not compete with main agricultural crops for water.
  - ✓ Tree species should be deep tap rooted so that they can draw water from deep strata of the soil.
- Tree species should not compete for plant nutrients
  - ✓ Tree species should not utilize more plant nutrients
  - ✓ They should help in building soil fertility,
  - ✓ Leguminous tree species which fix atmospheric nitrogen in their roots should be prfer.
  - ✓ The root system and root growth characteristics should ideally result in to exploration of soil layers that are different to those being trapped by agricultural crops.
- Tree species should not compete for sunlight
  - ✓ Tree species should not interrupt sunlight falling on the crops.
  - ✓ Tree species should be light branching in their habit.
  - ✓ Trees permit the penetration of light into the ground and promote better crop, pasture growth and yield.
  - ✓ Tree species can withstand pruning operation if it possess dense canopy.
- Tree species should have high survival rate and easy establishment
  - ✓ Trees species should have high survival percentage,

- ✓ Leave little or no gaps after transplanting.
- ✓ Hardy tree species are easy to establish.
- ✓ They have less mortality percentage because they can tolerate transplanting shocks easily.
- ✓ Trees should have the ability to regenerate lateral roots within a short period of time after transplanting.

- Tree species should have fast growing habit and easy management
  - ✓ Tree species for agroforestry system should be essentially fast growing,
  - ✓ Rapid growth, especially in the early years,
  - ✓ Tree should have short rotation (the period between planting and final harvesting)
  - ✓ Fast growing species such as *Poplar, Casuriana, Leucaena leucocephala* etc. are important species which provide lot of opportunities to be planted in AFS
- Tree species should have wider adaptability
  - ✓ A tree species selected for agroforestry combinations must have a wider adaptability.
- Tree species should have high palatability as a fodder
  - ✓ Most of the Indian farmers rear livestock separately and cut and carry method of fodder production is quite prevalent.
  - ✓ Therefore, in agroforestry, farmer must select those tree species which are palatable to livestock and had a high digestibility.
- Tree species should have shelter conferring and soil stabilization attributes
  - ✓ Some tree species, because of their inherent growth habit and adaptability, are especially helpful in providing protection for soils, crops and livestock. *Poplars (Populus spp.), Willows (Salix spp.), Casurina equisetifolia,* etc. for example, have been extensively used in soil erosion control because of their extensive root system and ability to grow in water-logged soils.
- Tree species should have capability to withstand management practices
  - ✓ Many agroforestry systems demand extensive pruning and lopping of the trees in order to maximize production. In such cases, the trees must be able to withstand such treatment without drastically restricting growth rate.
- Tree species should have nutrient cycling and nitrogen fixation attributes

- ✓ Within an agroforestry system, trees can play an important role in recycling nutrients, leached down through the soil profile and minerals released from weathering parent material such as rocks and sediments.
- ✓ These nutrients are used in the growth and development of the tree, many returning to the top-soil in form of dead leaves, twigs, flowers and seeds which slowly decompose on the surface, or are eaten by animals.
- ✓ Although all trees play some role in maintaining the nutrient status of the soil through recycling.
- ✓ Deciduous trees drop most of their leaves in autumn leaving a thick mat of leaves on the ground, whereas most evergreen species maintain some level of litter fall throughout the year.
- ✓ Another important factor is the ability of many tree species to convert atmospheric nitrogen into organic nitrogen for their own use through complex symbiotic relationship between Rhizobium bacteria and their fine roots.
- ✓ The bacteria form nodules on the roots which can convert nitrogen gas, as it is in the atmosphere, into usable nitrogen for the plant.
- ✓ Most leguminous trees and some non-leguminous ones, such as *Acacia, Leucaena and Prosopis* as well as Casuarina spp. fix the atmospheric nitrogen.
- ✓ The litter of these nitrogen fixing trees is generally high in nitrogen, thus increasing the nitrogen status of the soil.

4.3.2. Characteristics of agricultural crops for agroforestry

a) Agricultural crops should be short duration and quick growing.

b) They should be at least partially tolerant to shade.

c) Most of them should belong to Leguminosae family.

d) They should respond well to high density tree planting.

e) They should bear some adverse conditions, like water stress and/or excess of watering;

f) Crops should return adequate organic matter to soil through their fallen leaves, root system, stumps, etc.

g) Crops should appropriately be fitted in intensive or multiple cropping systems.

Some important crops in relation to agroforestry

Maize (lea mays)

Origin: Maize originated in Mexico and was introduced into East Africa as early as 1643 (Ngugi, Karau and Nguyo, 1990). The early varieties came from the Caribbean and were only suited to the coastal strip. The spread of maize into the highlands and medium-altitude areas, with a consequent decline in most places of the indigenous cereals, was largely due to the introduction by European settlers of varieties from South Africa (Acland, 1971).

Ecology: Maize has a higher yielding potential than the indigenous cereals where water and drainage are favourable. The young maize plant is moderately drought resistant, but from five weeks onwards it is less so. Maize requires well-drained soil and a good supply of nutrients.

Features in agroforestry: Maize is light demanding, so shade may reduce crop yields. It is sensitive to competition for moisture, so intercropped trees must be of a non-competitive type in drier areas. For example, Leucaena in hedgerows is not recommended in areas with less than 800 mm rain. Wind damage can be a problem, so trees are useful as windbreaks.

*Beans (*Phaseolus vulgaris*)*

Origin: South America.

Ecology: Beans are annual legumes and have the capacity to fix atmospheric nitrogen. The degree of nodulation is very variable, however: in some areas large nodules are formed while in others none are produced. Beans are not drought resistant and ideally they need moist soil throughout the growing period. High temperatures cause a poor fruit set. Beans demand free-draining soils with a reasonably high nutrient content.

Features in agroforestry: Beans are shade tolerant, and since they prefer lower temperatures they normally perform well under maize, bananas or other trees.

*Cassava (*Manihot esculenta*)*

Origin: Indigenous to Africa.

Ecology: Cassava is widespread in areas below 1,500 m, occasionally higher. It is very drought-resistant and is able to give good yields on poor soils. Cassava is suitable for areas with erratic rainfall where other crops may fail in bad years. Its main requirement is well-drained soil. As a result, cassava is one of the few crops that fits into a definite

rotational pattern on small holdings and owing to its undemanding nature is often planted as the last crop in the arable period before the land reverts to fallow. Weeding is only required during the first year; later weeds are tolerated. Cassava has been demonstrated to be a soil improver.

Features in agroforestry: Cassava appears to be sensitive to shade but not to other forms of competition from trees.

*Sorghum (*Sorghum vulgare*)*

Origin: Indigenous to Africa. It has been cultivated for more than 4,000 years in Egypt.

Ecology: Sorghum is drought-resistant and often out-yields maize under dry conditions. It is reasonably tolerant of waterlogging and yields comparatively well on infertile soils. Sorghum has twice as many roots as maize in a given volume of soil. The roots do not die back during drought and the leaves roll up to minimize transpiration. In this way the plant can remain dormant when other crops would be killed, and when the rains start again it recovers rapidly.

Features in agroforestry: Sorghum is sensitive to shade, as are all cereals. Birds, particularly Quelea, are one of the main causes of crop loss in sorghum: bird-susceptible varieties sometimes give no yield at all. Weavers, starlings, bishop birds and many other kinds of bird also attack sorghum but are less devastating than quelea. The exact role trees may play in attracting such birds has not been determined, and neither do we know if increasing perching sites for birds of prey, by pollarding trees for example, can reduce the damage by grain-eating birds.

*Finger millet (*Eleusine coracana*)*

Origin: Some millet is believed to be indigenous to eastern Africa, but they are now widely grown in both Africa and Asia.

Ecology: Finger millet tolerates dry spells in the early stages of growth, but after the first month it requires a steady supply of moisture if good yields are to be obtained. It is usually grown between 900 and 2,400 m in areas with at least 900 mm rainfall. It only yields well on fertile soils with good drainage.

Features in agroforestry: Similar to sorghum with regard to shade and bird problems.

*Rice (*Oryza sativa*)*

Origin: Southeast Asia is regarded as the center of origin for rice from where it has spread too many parts of the world.

Ecology: Rice is an unusual crop in that it can grow not only under waterlogged conditions but also in standing water. It prefers high temperatures and grows best below 1,000 m. Sandy soils can support rice, but only if there is a permanent high water table. Otherwise heavy soils are needed to retain irrigation water.

Features in agroforestry: There are practically no trees on the irrigation schemes in Kenya where rice is grown. Paddy fields are special environments and few trees can thrive there. Rice is also a shade-sensitive crop and wood supplies for irrigation schemes are best met from woodlots planted nearby.

*Tea (*Camellia sinensis*)*

Origin: From Burma tea has been taken too many other parts of the world. The first tea was planted in Kenya in 1903 near Limuru, but most tea plantations were established after 1945.

Ecology: Tea tolerates short dry spells but only produces well with adequate rainfall. The lowest altitude, at which it will grow well, 1,200 m, is set by scarcity of rainfall, whereas the upper limit, 2,200 m, is set by the incidence of frost. For good growth, soils should be deep, well drained and slightly acidic.

Features in agroforestry: Tea growing areas frequently experience strong winds and windbreaks are recommended. A tree species particularly well suited to use in tree growing areas is *Hakea saligna.* Armillaria root rot, *Armillaria mellea,* is a serious disease of tea in east Africa. Armillaria is promoted by the presence of old stumps and roots of trees which have been infected, so such stumps should always be carefully removed before new tea is established.

*Arabica coffee (*Coffea arabica*)*

Origin: Ethiopia. Coffee was introduced into Kenya in 1897 by missionaries. Coffee is one of the most valuable commodities in international world trade and is very important for Kenya's foreign exchange earnings.

Ecology: The best coffee areas in Kenya are between 1,400 and 1,900 m altitude, with rainfall of 1,500-2,250 mm. The best soils are well-drained volcanic soils, deep, fertile and slightly acidic.

Features in agroforestry: Coffee is shade tolerant, which enables farmers to grow trees in many spatial arrangements with the crop. Grevillea was originally introduced as a shade tree for coffee and is still the most popular tree in coffee-growing areas. Other common trees with coffee are *Cordia abyssinica* and *Albizia* spp. Armillaria root rot attacks coffee, so all old roots of trees that may harbour Armillaria should be removed when new coffee is established. In large plantations where there are no shade trees windbreaks should be considered.

*Bananas (*Musa *spp.)*

Origin: Bananas originally came from Southeast Asia, but were introduced to Africa many hundreds of years ago.

Ecology: For good yields bananas require a constant supply of moisture. They are thus most important in areas with well-distributed rainfall, e.g. Kisii and Kaka-mega. Bananas also require a warm climate, so the crop performs best at altitudes below 1,800 m. Bananas also require rich, deep and well-drained soils.

Features in agroforestry: Bananas are often used as a middle- or upper-storey crop with other crops being grown underneath. Sometimes they are mixed with taller trees. Occasionally bananas are also grown in monoculture. Bananas are shallow rooted, most roots being found in the top 15 cm of the soil. Therefore they are sensitive to wind damage and windbreaks or support stakes to prevent the banana plants from falling over are essential. Bananas are sensitive to high nematode populations in the soil. If the nematode population is too high banana cultivation must be halted temporarily and other crops grown until the nematode population has decreased.

Wheat (Triticum *spp*.)

Origin: South-western Asia. Wheat was introduced into Kenya early this century by the white settlers.

Ecology: The best wheat-growing areas are above 1,800 m with at least 750 mm rainfall. The soils should be well drained and have a high nutrient content.

Features in agroforestry: In some wheat-growing areas Acacia trees have been left in the fields, apparently with little or no reduction in yields. Strong winds may cause lodging, hence trees are useful for windbreaks. Some bird damage may occur, but it is not as serious as for sorghum and millet. Wheat is a light-demanding crop, so trees in

fields must either have a natural light shade or be managed to reduce the intensity of the shade

*Sweet potato (*Ipomoea batatas*)*

Origin: South America, but widespread in the tropics.

Ecology: Sweet potato is a crop which grows under a very wide range of ecological conditions from sea level up to 2,400 m, in a wide variety of soils, and in areas receiving more than 750 mm rainfall. Little weeding is required since the vines cover the soil very effectively and suppress most weeds.

Features in agroforestry: Sweet potatoes are not normally grown with an upper storey of trees, and in general trees do not have a big role to play in association with sweet potatoes.

*Tobacco (*Nicotiana tabacum*)*

Origin: South America from where it was brought to Europe and later by the Portuguese to Africa. Tobacco growing was initiated by the British American Tobacco Company (BAT) in the late 1930s, but it was in the 1970s that the cultivation of tobacco expanded considerably.

Ecology: Tobacco requires about 750 mm of rain and the altitude range is from sea level up to 1,260 m. A high light intensity is required for good production and the relatively low light intensities in Kenya result in low yields compared to those in some other countries. Crop rotation is required to avoid build-up of nematode populations.

Features in agroforestry: Curing tobacco requires fuelwood and BAT has long promoted tree growing among small-scale tobacco producers in Kenya. Recommended tree species are *Grevillea robusta, Cassia siamea, Markhamia lutea, Eucalyptus* spp., and to a lesser extent *Terminalia brownii, Gmelina arborea, Acacia albida, Cordia abyssinica, Sesbania sesban* and *Azadirachta indica. Eucalyptus* spp. cannot be used for fire-curing tobacco because of the odour the wood imparts to the smoke. Woodlots with a spacing of 2 x 2 m should be established, preferably on marginal land where little or no other production takes place. Planting of trees is also recommended on farm lands, e.g. on boundaries and terrace risers. In dry areas, water-harvesting methods are adopted. The light-demanding nature of tobacco limits its scope for intercropping with trees.

*Sugar cane (*Saccharum officinarum*)*

Origin: New Guinea. Sugar-cane growing expanded in Kenya during the 1920s with establishment of the first sugar factories.

Ecology: Sugar cane is a perennial grass which grows well at altitudes from sea level up to 1,600 m in areas with not less than 1,500 mm rainfall. It prefers heavy fertile soils.

Features in agroforestry: Sugar cane is strongly light demanding, so intercropping trees and sugar cane cannot be recommended when sugar cane is commercially grown. Sugar-cane growing areas are often those where severe shortages of wood are experienced, so establishment of woodlots and intensified tree growing around homesteads are recommended to meet the needs for wood. Under small-scale irrigation in the Kerio Valley sugar cane is sometimes grown with *Ficus sycomorus* and *Acacia tortilis.*

Self-check 4	Written test

Test II: Short Answer Questions

1. How challenges of agroforestry practice can be solved? (3points).
2. List priorities setting to choose agroforestry tree species (3 point)
3. Write desirable characteristics of tree for agroforestry (4 point)

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

Operation Sheet 1	Identify the agro-forestry technologies, packages or practices

Objective: To identify agroforestry/ practice technology

To demonstrate AF Practices in the selected area

Materials, tools and equipment required:

- Paper
- Pen
- Note pad

Procedure:

- ✓ Wear safety cloths
- ✓ Collect all tools, materials and equipment used for AF classification.
- ✓ Survey the environment and collect data.
- ✓ Identify the species
- ✓ List type of the identified agroforestry practice and their use

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1- Identify the agroforestry practice in the selected area

Task 2- Identify species type/diversity and its benefit

Lo#48	LO #2. Implementing appropriate agro-forestry technologies

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Observing OHS, legislative and organizational requirements
- Guidelines for implementing technological packages

Undertaking economic assessments, This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Observe OHS, legislative and organizational requirements
- Guidelines for implementing technological packages

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1. Observing OHS, legislative and organizational requirements

1.1. Occupational Health and Safety (OHS) requirements

Occupational health and safety (**OHS**) relates to health, safety, and welfare issues in the workplace. It is the laws, standards, and programs that are aimed at making the workplace better for workers, along with co-workers, family members, customers and other stakeholders.

OHS responsibilities: Different people may have different responsibilities in a workplace, depending on many things such as company culture, structure of the business, assigned responsibilities, shiftwork, locations of work sites, and reporting structures. Management, Employees and Contractor have responsibilities OHS.

These include:

- The use of PPE and clothing
- Safety equipment
- First aid equipment
- Firefighting equipment
- Hazard and risk control
- Elimination of hazardous materials and substances etc.

Personal Protective Equipment

Personal Protective Equipment (PPE) refers to equipment, which is used in the workplace by a person, to protect them from a hazard. It is the least preferred method for controlling hazards; however in some circumstances it is the only method available to minimize the risk.

Examples of Personal Protective Equipment (PPE) include:

- Safety Glasses
- Safety footwear (steel cap boots, shoes, rubber boots, non-slip shoes)
- Safety goggles, face shields
- Ear plugs, ear muffs
- Hard hats
- Overalls
- Gloves

- Gauntlets
- Respiratory protection (dust masks, respirators, self-contained breathing apparatus etc)

Safe Work Procedures can also be used during OHS and induction training. While compliance with legislative requirements is a duty under the OHS law, the development and implementation of safe work procedures has many additional benefits. These include:

- Allowing the business to structure an OHS training program based on the safe working procedures developed.
- Controlling procedures provides a basis for a safe place and system of work.
- Consistent task performance.
- Reduction of down time and lost time due to accidents.
- Improved productivity and profitability.
- Increased skill and understanding levels for employees.
- Assist in identifying suitable employment for injured workers.

1.2. Legislative requirements

In OHS legislation, accountability for workplace health and safety rests with the management of a business. This is contained in the Duty of Care principle. That said, others may also be accountable and therefore no workplace participant should think, or be allowed to think that safety is someone else's responsibility. In order to meet OHS legal obligations, a business needs to identify responsibilities in the workplace, so that everyone is clear about who will be taking responsibility for various safety activities, and who will be responsible for specific actions.

- Enterprise agreements
- Industrial relations
- Confidentiality and privacy
- Following OHS
- Environment protection
- Create equal opportunity for both male and female
- Anti-discrimination

- Heritage and traditional land owner issues

1.3. Organizational requirement

Some organizational requirements needed in OHS are:

- Following legal organizational and site guidelines
- Following appropriate policies and procedures
- Applying OHS requirements, emergency and evacuation
- Ethical standards
- Recording and reporting,
- Access and equity principles and practices
- Equipment use, maintenance and storage,
- Environmental management (waste disposal, recycling and re-use guidelines

A company Occupational Health and Safety Policy is a way of communicating the commitment to workplace health and safety, and documenting this commitment.

OHS Policies are:

- A statement of commitment by Management and the owners of the company, to workplace health and safety and to managing the process.
- Responsibilities for OHS are clearly defined in the policy. This will generally include Employees, Supervisors, Management, and Directors, and other workplace participants.
- Resources to be provided for the implementation of workplace safety, for example time to conduct workplace inspections, hold safety consultation meetings, or finances to provide equipment or training.
- Various activities that will occur in the workplace, such as inspections, training, safety programs, risk assessments, OHS information, etc.

Self-check 1	Written test

Test I: Short Answer Questions

1. Define occupational health and safety (OHS) requirements (3points).
2. List Legislative requirements at work place (3 point)
3. What are organizational requirement (3 point)

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Rating: _____

Note: **Satisfactory rating 9 points** **Unsatisfactory - below 9 points**

Information sheet 2. Guidelines for implementing technological packages

Guidelines for implementing agroforestry technology/ packages represents the step follows for integration of forestry and practices including crop production, pastureland management, animal husbandry, fish farming and a range of other agricultural enterprises with multi-agency collaboration as the key to success.

2.1. Getting started: determining the objectives of planting

This stage involves discussions with all local farmer user groups and other stakeholders on the current situation and the potential ecological, socioeconomic and political consequences of intervention. All stakeholders should agree upon the overall goal and the objectives of intervention. This stage involves the following steps:

- **Organizing farmers into user groups**: usually, ten farmers are organized into one group and each group then selects their own group leader or representative that can work with a project team.
- **Designating the land area for planting**: the user group negotiates with the county forest board for the designation of land (in this particular case, degraded sloping areas) where intervention will take place. Normally, one hectare will be designated to a user group. Soil conditions, road accessibility and water availability are often the principal concerns of user groups.
- **Agreeing management principles**: the basic ecological principles for restoration need to be agreed by and between user groups, for example, the level of tree covers to aim for, the basics of contour farming, and other soil and water conservation measures.

2.2. Looking for things to try: an assessment of current practices

The project team works with local user groups in a participatory rural appraisal exercise (explained further below) to collect and share information and determine current management practices. The exercise includes inventorying local knowledge, innovations and practices, and listing useful agroforestry species (native and exotic trees, and other species). Methods used in appraisal may include transect walks, mapping of land use and land use change, matrix scoring of species and cultivation practices, and ranking to identify the most promising agroforestry species for planting and the most appropriate management practices to adopt when doing so.

2.3. Designing field planting

The organizational structure of agroforestry planting depends upon:

- **The livelihood system**: decision makers can be user groups or households, based on their needs and resources
- **Land use categories**: the types of land available for current and future use, depending on soil type, water availability, slope, etc.
- **Particular practices**: agroforestry includes a broad range of practices where various trees are used for different production and protection purposes, determining how to plant Groups of agroforestry practices in space (at the landscape and/or watershed level) and time

2.4. Trying things out: Implementing chosen approaches

Together with user groups, the project team develops annual action plans for tree planting. With technical support from the project team, user groups then carry out field activities including land clearance, terracing, nursery establishment and production of tree seedlings, tree planting, annual crop and grass-strip cultivation, etc.. User groups document and monitor the performance of tree species in different production circumstances with the support of the project team. This provides for a mutual learning process of what works. Farmers and user groups are thus involved in generating economically and environmentally sound technologies for land use.

2.5. Sharing the results: spreading good practice

Users group can share experiences through group meetings and farmer-to-farmer visits. Visual materials including posters, photos, games and field demonstrations can be produced by local user groups and project team members to share important information on tree species and management practices.

2.6. Keeping up the process

The implemented agroforestry's user groups can work with their neighbours, with extension agents and with agroforestry researchers to continue the process of participatory agroforestry development.

Self-check 2	Written test

Test I: choose part

1. The organizational structure of agroforestry planting depends on (2 point)

A. The livelihood system B. Particular practices C. Land use categories D. All

Test II: Short Answer Questions

1. List step/ guidelines followed used for implementing agroforestry technology/packages (3 point)

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Rating: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Lo#49	LO #3 Identify and Implement potential income generation alternatives relevant to the community

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Informing the target community
- Organizing the target community and supplying inputs
- Providing trainings on the selected income generating
- Encouraging the target community
- Providing continuous technical support
- Facilitating market linkages

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Inform the target community
- Organize the target community and supplying inputs
- Provide trainings on the selected income generating
- Encourage the target community
- Provide continuous technical support
- Facilitate market linkages

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets

6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1. Informing the target community

1.1. Target community

Target community means a subset of the priority service population, such as those residing in specified area or catchment area, or a countywide target population that will be the focus for any project. Target groups may define as individuals or groups (families, teams, organizations) that generally live in a geographically circumscribed area (thus, in cities, individual municipal or rural districts).

The following questions will help you in describing the target group:

- Who are the members of the target group? How old are they?
- What geographic area do they come from (a particular city neighborhood, a rural district)?
- What are their social situation, family status, and/or education status?
- What is their financial situation?
- What problems are the target groups facing?
- What are the group's potentials and strengths to implement the technology adoption?

Descriptions of the existing situation and needs often emphasize target groups' problems and deficits. This is an obvious way forward, as most such projects are aimed at alleviating hardship. However, it is equally important to consider positive aspects. Therefore, you should ask:

- What development opportunities does the target group have?
- What strengths, talents and resources do its members possess?
- What are target-group members' wishes and hopes?

1.2. Informing target community about the technology

Informing people or providing information to target community helps them to understand and deciding to implement agroforestry practice/technologies which are used as potential income generation or alternatives for them. Agroforestry, the programme focus was mainly on agroforestry production, local business development and financial services. However, a challenge of how to improve farmers' adaptation strategies to climate variability was identified when impacts of land degradation,

flooding and drought became more pronounced on agricultural production. Farmers with well-developed agroforestry systems, soil conservation structures and croplands with high levels of organic matter have stronger resilience to negative effects of climate change.

1.3. Community income generation option

Agroforestry systems can be advantageous over conventional agricultural, and forest production methods. Agroforestry has the potential to solve many land-use problems. Some of the benefits that Agroforestry offers are: Soil-fertility improvement, Provision of wood products (fuelwood, poles, timber, fruits, medicines, etc.). Consequently, they have less and less time and energy to spend on other activities such as caring for children or engaging in income-generating activities. The benefits created by agroforestry practices are both economic and environmental. Agroforestry increases farm profitability in several ways:

- Nutrients are well kept and are continuously being recycled in the system,
- Total output per unit area of tree/crop/livestock combinations is greater than any single component alone
- Water management is an integrated part of the system
- Crops and livestock protected from wind are more productive and
- New products add to the financial diversity and flexibility of the farming enterprises and make the household less vulnerable. All benefits are explained more in detail below:

I. Income generating activities: The focus on farm enterprise development has led to farmers planning for their enterprises and choosing the most suitable ones that can give them high profits. A diversification of enterprises is also encouraged for reduced vulnerability to extreme weather and market fluctuations. The local groups and organizations play important roles in bulking of produce, value addition and transportation of products to better markets. Financial services have added on to the income generation and a saving and loaning culture has started where productive investments are increasingly common. The ability to take loans has lead to a felt increase in productive investments directly leading to higher incomes.

II. Health: The contribution of agroforestry to human health is important since many diseases in the communities are related to poor nutrition such as lack of proteins or vitamins. Most households with agroforestry systems have witnessed increased and diversified food production where fruits, vegetables and animal protein often are the difference between a balanced diets and deficiency diseases. The promotion of medicinal tree species and trainings in their uses has further contributed to improving the health of target communities.

III. Food and water: Food security Increased diversification of food production and increased productivity together with increased income, fruits, vegetables and honey production assists household in meeting their nutritional needs. In case of failure of one crop they have others to ensure that they are food secure.

Communities are trained on ways of harvesting rain water for domestic, livestock as well as for agricultural use. Some households are thereby able to grow vegetables during dry spells and get good market prices for their products. Through water harvesting and drainage systems on the farms, the farmers are able to mitigate the effects of drought as well as floods.

IV. Community empowerment: The agroforestry empowers the community through capacity building, study tours and provision of starter tree seeds. Farmer groups demand capacity building that can lead to an optimum production. Community resource persons are trained as trainer of trainers so that the knowledge can spread further and stay within the community after project has phased out.

In general agroforestry has generated income for the community/adopter through:

- Production of crops
- Fiber
- Fodder
- Food source
- Fuel
- Timber etc

1.3. Means to informing communities

- Web Site
- Brochures

- Business cards
- Phone line/voice mail
- Newspaper
- Word of mouth/face to face communication etc.

Self-check 1	Written test

Test: choose part

1. From the following which one is benefit of agroforestry practice? (2 point)

A. Solve land-use problems B. It generate income for community C. A and B

Test II: Short Answer Questions

1. Write community income generation option from agroforestry practice (3points).
2. List the way of informing community on the specific issue about technology (3points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Note: **Satisfactory rating 8 points** **Unsatisfactory - below 8 points**

Information sheet 2. Organizing the target community and supplying inputs

2.1. Organizing the target community

Bringing together a diverse group of people to achieve a common goal is a difficult task, which requires a variety of social skills and great investments of time and other important resources. Whenever possible it is advisable to utilize the services of an expert community organizer to assist in achieving operating/practicing the required technology. Grassroots organizing builds community groups from scratch, developing new leadership where none existed and organizing the unorganized. It is a values-based process where people are brought together to act in the interest of all communities and encouraging them in in increasing income generation by implementing new technology.

Deferent approach used to organize the target community to implement the technology

These include:

- Involving/participating community
- Facilitating informal meeting.
- Hold a larger community meeting.
- Choose an issue
- Do on the specific issue.
- Evaluate what you did – learn from what worked and what didn't.

2.2. Supplying inputs

Identifying seed sources and input supply is better to support community agroforestry.

Classification system used for agroforestry tree seed can reflect the different types of seed sources that are actually used by farmers and should facilitate involvement of decentralized producers and distributors. Furthermore, it should enable an understanding of how the biological and logistical characteristics of each source relate to opportunities for potential public–private collaborations that can optimize performance in delivery. Based on such thinking, suggested an alternative typology for tree planting material that accommodates the different types of sources found in landscapes and their multiple functions.

The three major components of the input supply can be identified as follows:

(i) Sources of reproductive material: Sources can all be categorized into five types

- Natural forest
- Plantation
- Farm land
- Seed orchard
- Vegetative propagation

(ii) Seed procurement (initial collection): The actors involved in collection depend on who owns and/or controls the seed sources and their capacity and willingness to make use of material.

(iii) Distribution of seed and seedlings: Some actors are able to afford to give away material during distribution, others makes an income from it.

The efficiency and reach of distribution is linked to the extension and marketing methods applied to species, varieties and provenances, and the information given to receivers on germplasm use and quality. The development of tree seed supply is similar to the evolution of crop seed systems, but seed supplying is more complex activities during seed processing and handling.

Self-check 2	Written test

Test I: Short Answer Questions

1. List approach used to organize the target community to improve and implement agroforestry technology (3points).
2. Write the supply input required by farmers for agroforestry practice (3points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Note: **Satisfactory rating 6 points** **Unsatisfactory - below 6 points**

Information sheet 3. Providing trainings on the selected income generating

There are different types of agroforestry's income generation opportunities like Wood fiber, lumber, specialty forest products, food

3.1. Selected income generation option

Windbreak: Multiple row windbreaks are places to produce marketable products like *hybrid poplar, wood, nuts, apples, cherries, blackberries* and woody floral products. Evergreens can be sold as Christmas trees, boughs for seasonal floral products or as landscaping plants, while adding color to farms and providing protection for birds and other wildlife.

Forest farming: Well-managed woodlots can potentially produce high quality lumber, firewood and valuable specialty forest products like *maple syrup, ginseng* and other medicinal plants, which are grown under shade. *Pine straw* may be another income-generating option from loblolly or longleaf pine plantations where there are markets.

Alley cropping: *Blueberries, chokecherries, elderberries, chestnuts, hazelnuts*, and many others have great potential when marketed as locally grown products. Possible inter-crops include vegetables, horticultural plants, forages and traditional row crops. This system will be producing valuable products while protecting the land.

Riparian forest buffer: Trees, shrubs, forbs and grasses along a waterway can be designed to achieve conservation purposes such as improved water quality and reduced flood damage, while also yielding a variety of products. These include wood from high-value species such as walnut, oak, maple, plants used for medicinal and botanical purposes, food (berries, nuts and mushrooms), specialty woods and woody florals.

Silvopasture: Tree canopies provide livestock with shade and wind protection and may yield additional income when the trees or tree products are harvested. The branches and leaves of some trees can be pruned from the trees and fed directly to livestock. Pine stands and nut and fruit orchards may be grazed to produce income before and while trees are bearing and growing.

Contour hedgerows: This is a form of alley cropping adapted for planting on sloping land. The hedges are planted along the contour. The functions for soil conservation are:

- Cover effect of vegetation and by laying pruning on the cropped alleys.

- To reduce surface runoff, increase infiltration and reduce soil loss through their barrier effect.
- To develop terraces progressively, through the accumulation of soil upslope of hedgerows and stabilization of the risers by stems and roots.

Trees can be planted on terrace risers. They are then either pruned or coppiced and serve the following multi-purpose functions;

- Stabilization of terrace risers, reducing the need for maintenance.
- Production of fuelwood, fodder or fruit
- Cover protection by canopy and by encouraging under storey growth

3.2. Providing trainings

Training is teaching, or developing in oneself or others, any skills and knowledge or fitness that relate to specific useful competencies. Training has specific goals of improving one's capability, capacity, productivity and performance. It forms the core of apprenticeships and provides the backbone of content at institutes of technology. In addition to the basic training required for a trade, occupation or profession, training may continue beyond initial competence to maintain, upgrade and update skills throughout working life. People within some professions and occupations may refer to this sort of training as professional development.

Methods of training

- **Technology-based learning:** Common methods of learning via technology include:
  - ✓ Basic PC-based programs
  - ✓ Interactive video - using a computer in conjunction with a VCR
  - ✓ Web-based training programs In-house
- **Simulators**
  - ✓ Simulators are used to imitate real work experiences.
- **On-The-Job Training**

Here are a few examples of on-the-job training:

- Read the manual
- A combination of observation, explanation and practice.
- In-house or external training programs
- One-on-one supervision

Self-check 3	Written test

Test 1: choose part

1. Which methods used to provide/offer trainings for community on the selected income generating option (2 point)

A. Technology-Based Learning B. Simulators C. Simulators

D. All E. None

Test 2: Short Answer Questions

1. List the common methods of learning via technology (3points).
2. List agroforestry practice that used for community as source of income (3points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____

Note: **Satisfactory rating 8 points** **Unsatisfactory - below 8 points**

Information sheet 4. Encouraging the target community

Encouraging target community is an important to address the political, social, economic and technological needs of farmers. There is a wide range of forest products which rural women and men gather, produce and trade in order to derive income. Gathered products include fuelwood, rattan, bamboo, fibers, medicines, gums and wild foods. The main groups of traded products which first undergo simple processing at the household or small enterprise level are furniture, other products of wood - such as baskets and mats and other products of canes, reeds, grasses - and handicrafts.

The first two product groups serve predominantly rural household and agricultural markets, and are usually their principal source of supply, while much of the handicrafts output goes to urban markets. The large component of small enterprise operations in the forest sector reflects the size of rural markets for forest products, and the dispersion of these markets across large areas with a relatively poor transport infrastructure, so that they are more effectively supplied locally. Small forest based gathering and processing enterprises provide one of the largest sources of non-agricultural employment and income to rural people.

There has been a steady evolution of services that are provided to motivate community or increasing new services.

Ways to encourage these communities are through:

- Provision of farm inputs;
- Offering information;
- Training;
- Technical assistance;
- Research; and
- Marketing services.

Self-check 4	Written test

Test 1: Short Answer Questions

1. List ways to encourage communities to adopt agroforestry practice (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Information sheet 5. Providing continuous technical support in agroforestry

I. Alley cropping

Alley cropping is a simultaneous agroforestry practice where crops are grown between lines of planted trees and/or shrubs, preferably leguminous species, which are pruned periodically during the crop's growth to provide green manure and to prevent shading of the growing crop. This technology helps increase production and land productivity by maintaining and improving soil moisture and fertility. Alley cropping is suited to humid and sub-humid tropics, and there is great potential for use of the system in Ethiopia, particularly to improve soil and water conservation in the hilly and mountain areas.

Criteria for selection of species: The multipurpose tree species in this agroforestry practice should bear the following important characteristics:

- Fast growing – benefits became available to the farm family as soon as possible; Good coppicing ability (re-sprouting)
- High biomass production
- Deep rooting habit
- Freedom from pests and diseases
- Nitrogen fixing ability (leguminous)
- Adaptable to close spacing

Establishment and spacing: The establishment of alley cropping requires many trees or shrubs and therefore a cheap propagation tree spp. is preferable. Direct seeding or use of cuttings would be ideal, but so far seedlings have been used in most research experiments. The spacing used in field trials has ranged from 4 to 8 m between rows and 2.00 m within rows. In humid areas, close spacing can be tolerated, but in drier conditions a wider spacing is required if competition for moisture is not to be too severe. On flat land, hedgerows should be oriented in an east-west direction to reduce shading. On sloping land, hedgerows must be oriented along the contours. Live fences are barriers of closely spaced trees or shrubs to protect crops or structures against livestock and human interference. It may be established all around the farm, but it is commonly established around the homesteads and gardens. It is commonly practiced in Ethiopia. Live fences can be combined with other trees for production of wood and fruits. They

can be made of single or multiple densely planted rows. Alternatively, one row of living fence posts can be planted widely spaced, with wire, sticks or dead branches between the trees. The use of live fences is a cheap method of fencing large areas because once the live fences become established they are permanent. Their establishment requires no expensive materials to be purchased and they are easy to maintain. Living fences may also give produce, e.g. fruits.

II. Windbreaks: Windbreaks are lines of trees or shrubs planted to protect fields, homes, institutions, etc from wind damage. Where wind is a major cause of soil erosion and moisture loss, windbreaks can make a significant contribution to sustainable production. It plays an important role in preserving soil and its fertility as well as improving the microclimate for crops. Well-designed windbreaks, i.e. ones that are not too dense, not only reduce wind speed but may also increase humidity and reduce water loss from the soil

Establishment and spacing: Any propagation method is suitable, but the main method of establishing windbreaks is by seedlings. It can either consist of a single line of trees with a spacing of 1.5-2.0 m, or two lines with a spacing of 4-5 m within the line and 2-4 m between the lines. In addition to one or two lines of trees, a line of shrubs spaced at approximately 1 m can be planted on the side facing the prevailing wind. The spacing between trees may vary with species. The windbreak must not be too dense. If the wind is blocked completely, it will cause turbulence over crops. Windbreak must be semi-permeable by the wind to slow it (dramatically reduced wind speeds).

III. Improved fallows

One method in which resource-poor farmers combats soil infertility is by leaving degraded land without cultivation. This abandoned land is referred to as ‘fallow’, and it is an option for improving soil fertility and it has been practiced for many generations.

The primary aim of improved fallow is promotion of food security through increased soil productivity. The improved fallow technology involves deliberate planting or sowing of nitrogen-fixing leguminous tree or shrub species. This technology has potential to restore soil fertility more rapidly than the traditional fallows and, hence, allow shortening of the fallow period. This practice has a potential to cut down fertilizer costs.

Establishment and spacing: Since very many individual shrubs are required, all with a relatively short life span, a simple and cheap propagation method is necessary. Sesbania sesban has such characteristics. Use of seedlings is expensive; direct sowing is the best option. Planting short-lived shrubs at 1 m x 1 m or 90 cm x 90 cm is recommended. The denser the spacing the more effectively will weeds be suppressed.

Improved fallows can be sown with a mix of species to obtain more benefits, e.g. Sesbania sesban with Cajanus cajan.

Management Aspects: The shrubs require little management once they are well established. Weed during establishment to improve growth of the shrubs and protection from livestock is necessary. If the shrubs are very densely spaced some thinning can be done. Cut short-lived shrubs after 2-3 years and there after let the crops grow.

Criteria for selection of species: Rate of tree growth and biomass production: fast growing tree species with high biomass production are best suited for improved fallows.

Quality of residues: the tree residues should be high in nitrogen.

Ease of propagation: must take a short time to germinate

Manageability: must be easy to manage

Pest and disease tolerance: species must not easily give way to disease and pests.

Adaptability: must grow easily in targeted ecosystem.

IV. Contour vegetation strips

In many traditional African farming systems, living barriers of grasses, lines of stone or wood, are placed across hillsides to control runoff and soil erosion. Combinations of trees, shrubs, grasses and creeping vines planted along the contour can serve the same purpose. They result in greater structural stability and can provide a higher yield and diversity of useful products. The contour strip is also known as a barrier strip or hedge, horizontal vegetation strip, contour hedge or horizontal hedgerow.

It is an erosion-control measure for sloping farmland, which provides useful products and enriches the soil. The establishment and maintenances of horizontal strips of vegetation on sloping ground is one of the most direct, cost-effective and ecologically sound erosion control interventions. If the strips are dense and wide enough, they can stop water from flowing downhill and trap soil particles in a web of vegetation and litter.

The effectiveness of contour vegetation strips depends in large part on slope, rainfall intensity and soil conditions. For conserving soil and water, the two most important factors are the width of the strips and the interval between them. The strips consists of one or two rows of shrubs and trees with at least one line of tightly spaced grasses planted on the down slope side to trap eroding soil.

Some technical supports to be provided during agroforestry operation are:

1) Identifying the problem.
2) Understand technical gaps of technology.
3) Understand the impact.
4) Avoid through intervention
5) Implement new technology

Self-check 5	Written test

Test 1: Short Answer Questions

1. List criteria for selection of species multipurpose tree species in agroforestry practice (5points)
2. List seven technical supports to be provided during agroforestry operation (5points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____
Rating: _____

Note: **Satisfactory rating 10 points** **Unsatisfactory - below 10 points**

Information sheet 6. Facilitating market linkages

Facilitate market linkages between farmers and various markets e.g. processors, local supermarkets, municipal markets, hospitality, etc. Potential linkages of producers with overseas markets are also supported through market development. Producers are also assisted with logistical arrangements. Different researcher point out the good available agroforestry products markets is a motivation for farmers' adoption to agroforestry technologies as it's provides a window for income generation. According to Hellin and Higman (2002) farmers' adoption to agroforestry technologies has the potential to increase agricultural output and reduce poverty whilst providing opportunities for large markets.

Improved market infrastructure can increase the availability of agroforestry products on markets. Supporting policies for appropriate market set-up and desired skills with respect to local and improve agroforestry technologies appear to suggest prospects for effective continued community and households' development. Marketplace restrictions have a significant role in hampering the improvement of agroforestry technology adoption. Agroforestry is adopted on a measure that has significant economic, social and environmental bearings; it is essential that markets for agroforestry tree products are expanded. For this to occur there must be robust relations between tree domestication and product commercialization.

Ways to facilitate market linkages between farmers and various markets are:

- Create a list of potential market opportunities.
- Identify farmers' strengths and limitations.
- Compare market opportunities with farmers' strengths and.
- Investigate the short list in detail

Self-check 6	Written test

Test 1: Short Answer Questions

1. List ways to facilitate market linkages between farmers and various markets (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Lo#50	LO #4 Monitor and review agro-forestry practice

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Establishing communication with community
- Monitoring agro-forestry operations
- Monitoring organization of duties, practices, equipment and materials
- Reviewing operational plans and site practices
- Monitoring and recording community environmental goals
- Monitoring training and operational controls
- Recording and reviewing improvement recommendations
- Making plans to introduce change

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Establish communication with community
- Monitor agro-forestry operations
- Monitor organization of duties, practices, equipment and materials
- Review operational plans and site practices
- Monitor and record community environmental goals
- Monitor training and operational controls
- Record and review improvement recommendations
- Making plans to introduce change

Learning Instructions:

Read the specific objectives of this Learning Guide.

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2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
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4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Establishing communication with community

Communication: Is the transmission of information from a source to its destination (receiver). It is the way of sharing or exchange of information, feelings or ideas with somebody (parents) at the workplace.

1.1. Communication process

Sender: The person who sends the message.

Receiver: The person who receives the message.

Message: Subject matter of communication. It may contain facts, ideas, feelings or thoughts done while operation or activities.

Feedback: Receiver's response or reaction or reply to the message, which is directed towards the sender.

1.2. Method of communication

Means of communication used during agroforestry operations are:

- Verbal Communication.
- Non-Verbal Communication
- Written Communication.
- Listening.
- Visual Communication.

Self-check 1	Written test

Test 1: Short Answer Questions

1. Define communication (2points).

2. List methods of communication used during agroforestry operations (5points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____

Note: **Satisfactory rating 7 points** **Unsatisfactory - below 7 points**

Information sheet 2- Monitoring agro-forestry operations

Monitoring is used to determine whether prescribed practices are being followed and if they are having the desired effects. It therefore provides a basis for modifications to improve practices and identifies areas in which corrective or remedial action is required.

2.1. Monitoring agro-forestry operations

Operational monitoring is used to determine whether prescribed practices are being followed and if they are having the desired effects. It therefore provides a basis for modifications to improve practices and identifies areas in which corrective or remedial action is required. Operational monitoring is used to determine whether prescribed practices are being followed and if they are having the desired effects. It therefore provides a basis for modifications to improve practices and identifies areas in which corrective or remedial action is required.

Typically monitored operations include:

- Occupational Health and safety
- Harvesting tools and equipment
- Harvesting and post harvesting activities
- Timber production
- Road construction
- Observation of protected zones
- Conservation programmes and measures Regeneration
- Management activities (Thinning, pollarding, lopping, coppicing,pruning etc.)
- Other silvicultural treatments
- Worker (contractor) performance
- Productivity unit and total costs etc.

Monitoring pre-harvest and harvest activities: Operators are responsible for monitoring their own operations to ensure that standards are observed. Operators should (and may be required by law to) undertake statistically sound sampling of specified operational aspects, with the monitoring method depending on the type of operation. Serious deviations from operational standards should be reported in writing to the overseeing body. Sampling procedures should be designed to suit the operations to

be monitored; for example, operators can ensure through monitoring. E.g. the residual stands have used to understand the desired basal areas and species compositions after thinning.

Monitoring post-harvest: is a systematic check to determine whether a harvesting operation (usually of wood, but also of non-wood forest products) has followed the harvesting plan and met its objectives while complying with established economic, social and environmental standards of practice. Post-harvest assessments can be done for every operation, or for selected operations. If conducted while the harvest is in progress, monitoring can include direct observations of workers and operating equipment and enable immediate remedial action (if required).

Parameters that could be measured in post-harvest assessments include:

- The effectiveness of directional felling and grading;
- Whether cutting and extraction have followed harvesting plans;
- Volume and value losses caused by poor practices;
- The location and standard of roads,
- Landings and skid trails compared with plans, and reasons for major diversions from plans;
- The impacts of roads, landings and skid trails on drainage and erosion;
- The extent of soil disturbance;
- Impacts on potential crop trees, r
- Regeneration and wildlife;
- The extent to which conservation prescriptions and protected areas have been respected;
- The appropriateness of disposal methods for chemicals and related waste;
- The availability and use of appropriate personal protective equipment; and living conditions in workers' camps

Typically monitoring operations include:

- Thinning
- Pollarding
- Lopping

- Coppicing and
- Harvesting production
- Other silvi-cultural treatments

2.2. Basic monitoring techniques

Some basic monitoring techniques uses are:

- Observation.
- Talking with people.
- Monitoring work performance and output.
- Employee surveys (before, during and after the change)

Self-check 2	Written test

Test 1: choose part

1. From the following which one is not basic monitoring techniques (3points).

A. Observation. B. Talking with people. C. A and B E. None

You can ask you teacher for the copy of the correct answers.

Test II. **Short Answer Questions**

1. Write type of agroforestry monitoring operation (4 point)
2. List parameters that could be measured in post-harvest assessments (3 point)

Answer Sheet

Name: _____

Score = _____
Rating: _____

Note: **Satisfactory rating 10 points** **Unsatisfactory - below 10 points**

Information sheet 3- Monitoring organization of duties, practices, equipment and materials

3.1 Monitoring organization of duties

Monitoring organization of duties includes:

- Safety Officers
- Supervisors
- Suppliers
- Clients
- Colleagues and Managers

3.2 Monitoring agroforestry practices

- Measurement of improvement outcomes,
- Coaching and mentoring of personnel in regard to new methodologies and
- Control of environmental conditions

3.3 Monitoring equipment and materials

A lot of equipment and materials are used in agroforestry operation. For the OHS from producer to dealers one should know the following safety issues.

Self-check 3	Written test

Test 1: Short Answer Questions

1. List points which have to be considering during monitoring agroforestry operation (3points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 7 points** **Unsatisfactory - below 7 points**

Information sheet 4- Reviewing operational plans and site practices

Some activities following during reviewing operational plan and site practice are:

- Comparing actual performance against planned performance.
- Document the differences between actual and planned performance.
- Identify the reasons for any differences.
- Use proper tools to maintain the machine and check
- safe operation of the equipment
- Reviewing site practices
- Checking weather working area is safe during operating
- Environmental management (waste disposal, recycling and re-use guidelines
- Implement action strategies to adapt performance or alter the operational plan

Self-check 4	Written test

Test 1: Short Answer Questions

1. Some activities following during reviewing operational plan and site practice (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Information sheet 5- Monitoring and recording community environmental goals

Organizational requirements are about clearly defining the tasks and responsibilities of workers and supervisors. The clear instructions should be given to workers, in written where appropriate, but at least verbally. Monitoring tasks in a safe manner is used to undertake in accordance with legislative requirements and environmental management goals. The fundamental value of the environmental management system (EMS) is that it enables any forest enterprises to arrange and focus its' management activities into an integrated, functioning system (including administration, planning and operations) with particular emphasis upon environmental impacts and risks.

More specifically, the EMS encourages the following:

- Corporate commitment to excellence in forest management, and related quality control
- Development of a foundation to address resource management activities and practices
- Application of continual improvement principles and procedures
- Assignment of physical and human resources to appropriate activities
- Assignment of personal responsibilities and accountabilities
- Development of good record keeping processes and procedures
- Implementing sustainable forest management (SFM) standards

Self-check 5	Written test

Test 1: Short Answer Questions

1. How environmental management system (EMS) used to monitor community environmental goals (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Information sheet 6- Monitoring training and operational controls

Training monitoring is a process through which the institution can assess whether the training is implemented as per the action plan or whether there is any significant deviation as envisaged in the plan.

The overall purpose of monitoring of any training design is to generate regular feedback from the field for incorporation into the training programs for continuous updating and enrichment of training designs.

The domain of operations monitoring and control concerns all activities related to the actual transportation process. It is also known as real-time control, or operations management. The supply basis for each operating day is known as a production plan, composed of the planned work of each available resource. It includes for instance all dated journeys planned on the considered day.

How do you monitor a training program?

- Situation observations of management and **training** areas.
- Physical verification of institutional facilities.
- Checking of training records/materials.
- Formal and informal discussions.
- Review training targets and achievements.
- Identify implementation problems.
- Review pre and posttest results.

Here are some basic monitoring techniques you might use:

- Observation.
- Talking with people.
- Monitoring work performance and output.
- Monitoring absenteeism and staff turnover.
- Employee surveys (before, during and after the change)
- Baseline measuring before and after the change.
- Benchmarking with other work units.

Self-check 6	Written test

Test 1: Short Answer Questions

1. How do you monitor training and operation (3points).
2. Lis basic monitoring techniques (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 8 points** **Unsatisfactory - below 8 points**

Information sheet 7- Recording and reviewing improvement recommendations

Records are preserved and archived for retrieval as needed as the following:

- Records of all data and information required
- Operational records
  - ✓ Pollarding
  - ✓ Pruning
  - ✓ Coppicing
  - ✓ Looping
  - ✓ Thinning activities
- Input and output records
  - ✓ Land
  - ✓ Tools (cutlass, chisel, spraying machine, etc.)
  - ✓ Planting materials i.e. tree seedlings, seeds of food intercrops planted in the first to take advantage of the soil rent on clearing of vegetation for tree establishment
  - ✓ Herbicides and manual weed control
  - ✓ Labor for land preparation, planting, maintenance and harvesting of wood
- Input cost for trees and crops including for raw material for shading and mulching nursery seedling are:
- Return from trees and crops
  - ✓ Incomes from corn yield
  - ✓ Wood yield by pruning, thinning etc
  - ✓ Fodder
  - ✓ Selling products as fruits, leaves, corns, and
  - ✓ Timber products.
- Site work procedure
- Recording legible, identifiable and traceable operation/activity.
- Other activities included in recording and reporting are:
  - ✓ Quality outcomes or technology requirements
  - ✓ Environment safety assessment

- ✓ OHS and hazard issues,
- ✓ Difficulties or problems Wastage/damage of tools, equipment and machinery
- ✓ Workout comes

- Finally The records are stored and maintained as needed

In general; the following information is recorded and reviewing for farther work activities improvement and recommendations of change if any.

- Job specification
- Location of the worksite;
- Required tools and machines;
- Identified risks and relevant safety rules;
- Required personal protective equipment;
- Information about rescue procedures in the event of an accident requiring evacuation;

Self-check 7	Written test

Test 1: choose part (3points).

1. Which one is **not** activities included in recording and reporting

   A. Quality outcomes or technology requirements

   B. Environment safety assessment

   C. OHS and hazard issues,

   D. All

   E. None

Test II. **Short Answer Questions**

1. List some information included under operational records (4 point)
2. List some information included under Input and output records (4 point)

Answer Sheet

Score = _____

Rating: _____

Name: _____

Note: **Satisfactory rating 10 points** **Unsatisfactory - below 10 points**

Information sheet 8- Making plans to introduce change

The management plan should be adapted to changing circumstances and in achieving production goals. Management changes may be required when, for example: trees start competing with crops for space, sunlight and nutrients; markets for products change; and there are changes in labor requirements or availability

The retention times of records have been established, recorded and communicated to staff.

- Promoting sustainable management practices.
- Increasing social acceptability levels
- Minimizing the loss of product during operation
- Allowing the use of local values and knowledge
- Greater job satisfaction which in turn increases productivity
- Reduced costs of production
- Empower all youth and women's in the activities

Self-check 8	Written test

Test 1: Short Answer Questions

3. List how management plan should be adapted to changing (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Lo#51	LO #5. Develop new and flexible approaches

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Developing new systems and technologies
- Checking new systems for improvements
- Monitoring care for the environment
- Conducting progress reviews

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Develop new systems and technologies
- Check new systems for improvements
- Monitor care for the environment
- Conduct progress reviews

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Develop new and flexible approaches

Develop new and a flexible approach the technology involves:

- Developing and trial new systems and technologies on site
- Check new systems for effective improvements or time savings & modify for implementation.
- Monitor and care for the environment through integration into all day-to-day activities.
- Conduct progress reviews to assess impact of improvement and on the environment.
- Record and report forestry operation procedures in line with workplace procedures

Self-check 1	Written test

Test 1: Short Answer Questions

1. How we develop new and a flexible technology (5points).

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Information sheet 2- Checking new systems for improvements

Checking new systems for improvements is an ongoing effort to improve products, services, or processes. It's is a six-step systematic approach to plan, sequence and implement improvement efforts using data and elaborates on the Shewhart Cycle (Act, Plan, Do, Study). It is methodology which enables understanding the improvement process. The continuous improvement always links back to each organization's own goals and priorities.

Why new improvement process needed

- Increase productivity,
- Better teamwork and morale,
- Greater agility,
- Less waste,
- More efficiency
- Increase in profit.

The six (6) Steps for new systems improvements

Step 1: Identify Improvement Opportunity: Select the appropriate process for improvement.

- Evaluate Process:
- Select a challenge/problem

Step 2: Analyze: Identify and verify the root cause(s).

Step 3: Take Action: Plan and implement actions that correct the root cause(s).

Step 4: Study Results: Confirm the actions taken to achieve the target.

Step 5: Standardize Solution: Ensure the improved level of performance is maintained.

Step 6: Plan for the Future:

- Plan what is to be done with any remaining problems
- Evaluate the team's effectiveness Set a target for improvement

Self-check 2	Written test

Test 1: Short Answer Questions

1. Why new improvement process needed (5points).

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

Information sheet 3- Monitoring care for the environment

Environmental monitoring is a tool to assess environmental conditions and trends, support policy development and its implementation and develop information for reporting. Environmental health addresses all human-health-related aspects of the natural environment and the built environment.

Environmental care concerns include:

- Air quality Including both ambient outdoor air and indoor air quality
- Disaster preparedness and response.
- Climate change and its effects on health.
- Environmental hazards, such as air, soil, and water pollution.
- Food safety, including in agriculture, transportation, food processing, wholesale and retail distribution and sale.
- Hazardous materials management, including hazardous waste management
- Land use planning including smart growth.
- Occupational health and environmental hygiene.
- Solid waste management, including landfills, recycling facilities, composting and solid waste transfer stations.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I short answer

1. Define what environmental monitoring mean **(4%)**

. Answer the following question!

Note: Satisfactory rating 4 points **Unsatisfactory below 4 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Information sheet 4- Conducting progress reviews

4.1. Progressive review

A progress review is an opportunity for you and your employee to engage in substantive discussions about:

- The strengths and/or weaknesses of the employee's performance,
- Measures that may be taken to correct any performance deficiencies and/or to improve performance that is otherwise acceptable,
- Employee developmental opportunities to enhance performance,
- Positive feedback to encourage continued performance,
- Additional resources available to assist with overall performance,
- Project status, deadlines, expectations, etc

4.2. How to Conduct Progress Reviews

1. Prepare for the progress review
   - Encourage employees to provide "self-assessments" of their performance
   - Review documentation on employee performance
2. Conduct the progress review discussion with the employee
   - Open the discussion
   - Discuss Key Issues
   - Conclude the Discussion
   - Conclude the Progress Review
     - Address necessary modifications to goals, standards, or performance plans.
     - If there are performance deficiencies, identify specific steps that should be taken in the future to address those. Contact your servicing Command Staff Advisor (CSA) or Human Resources Specialist (HR Specialist) as soon as possible for further advice and guidance.
     - When significant changes in organizational priorities or other events occur that impact any of your employees' performance plans, initiate a discussion between you and the Reviewing Official.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Why recording is important **(4%)**
2. List the important recording agroforestry operation procedure (6%)

. Answer the following question!

Note: Satisfactory rating 10 points **Unsatisfactory below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Lo#52	LO #6 Record and report information work outcomes

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Recording and reporting agro-forestry operation procedures
- Reporting problems or difficulties in completing work
- Documenting and reporting work completion

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Record and report agro-forestry operation procedures
- Report problems or difficulties in completing work
- Document and report work completion

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Recording and reporting operation procedures

1.1 Recording operation procedures

Recording is an essential task in any work activities. It is necessary for planning, monitoring and reviewing progress at individual, service, organizational and locality levels. Recording ensures that there is a documented account of work undertaken. It supports continuity of operation when there is a change of any situation and provides a means for managers to monitor work. Recording is a major source of evidence when there are critical incidents or enquiries.

Recording is essential to:

- Collect information about the operation activities
- Analyze the outcome focused service development
- Improve the outcome focused assessment and planning
- Record ongoing support activities
- Monitor outcome focused review

SMART principles can usefully be employed when discussing and recording the operational outcomes.

Your record has to be:

S - Specific (or Significant).

M - Measurable (or Meaningful).

A - Attainable (or Action-Oriented).

R - Relevant (or Rewarding).

T - Time-bound (or Trackable)

1.2. Reporting agro-forestry operation

Report is a statement of the results of an investigation or of any matter on which definite information is required. The following stages are involved in writing a report:

- Clarifying your terms of reference
- Planning your work
- Collecting your information
- Organizing and structuring your information
- Writing the first draft
- Checking and re-drafting

Some activities included in recording and reporting are:

- Aagroforestry operation procedures such as
  - Pollarding
  - Pruning
  - Coppicing
  - Thinning activities
- Quality outcomes or technology requirements
- Environment safety assessment
- OHS and hazard issues,
- Difficulties or problems Wastage/damage of tools, equipment and machinery
- Workout comes

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Why recording is important **(4%)**
2. List the important recording agroforestry operation procedure (6%)

. Answer the following question!

Note: Satisfactory rating 10 points **Unsatisfactory below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet 2- Reporting problems or difficulties in completing work

2.1. Reporting problems

There are many problems or difficulties in completing work such as:

- Non-routine process and quality problems
- Equipment selection
- Availability and failure of doing tasks
- Teamwork and work allocation problem
- Safety and emergency situations and such incidents.
- Identify problems, environmental issues and equipment faults

2.2. Reporting difficulties in completing work

These include**:**

- Common Workplace Issues
- Interpersonal conflict.
- Communication problems.
- Discrimination.
- Low motivation and job satisfaction.
- Performance issues.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List reporting problem **(**4%)

2. Write down reporting difficulties (3%)

List down things that work place documentation contains

. Answer the following question!

Note: Satisfactory rating 7 points **Unsatisfactory below 7 points**

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Answer Sheet

Name: _____ Date: _____

Information sheet 3- Documenting and reporting work completion

3.1. Documenting work completion

Documentation plays a crucial role in any treatment setting. Documentation helps to assure continuity of care and assist the adopter/farmers. It's important for practitioners, who may serve the community down the line have proper information. Not all documents are records. A record is a document consciously retained as evidence of an action.

Workplace documents measures skills that individuals use when they read real workplace documents and use that information to make job-related decisions and solve problems.

The work place documents include:

- Messages
- Emails
- Letters
- Directions
- Address
- Policies and regulations.

Records management systems generally distinguish between records and non-records (convenience copies, rough drafts, duplicates), which do not need formal management. Many systems, especially for electronic records, require documents to be formally declared as a record so they can be managed. Once declared, a record cannot be changed and can only be disposed of within the rules of the system.

3.2. Reporting work completion

As its name implies, a completion report is written when an operational activities has come to an end. Work completion report is a section in the settings of every activity and resource that allows you to set how that activity or resource can be marked as complete.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Why documenting work operation is important (4%)
2. List down things that work place documentation contains (3%)

. Answer the following question!

Note: Satisfactory rating 7 points **Unsatisfactory below 7 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Reference Materials

An Introduction to Agroforestry P.K. Ramachandran Nair

Chamshama, S.A.O., Monela, G.C., Sekiete, K.E.A. *et al.* Suitability of the taungya system at North Kilimanjaro Forest Plantation, Tanzania. *Agroforest Syst* **17,** 1–11 (1992). https://doi.org/10.1007/BF00122924

Hellin J and S Higman, (2002). Smallholders and niche markets: Lessons from the Andes. Agren Network Paper No. 118, ODI Agricultural Research and Extension Network, London. 16 pp

Hodge, Sandra; Garrett, H. E.; and Bratton, Jerry, "Alley Cropping: An Agroforestry Practice" (1999). Agroforestry Notes (USDA-NAC). 11.

Hodge, Sandra; Garrett, H. E.; and Bratton, Jerry, "Alley Cropping: An Agroforestry Practice" (1999).

practitioners. The World Agroforestry Centre, East Asia, Kunming, China. 63 pp.

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The Member States are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.

Xu J, Mercado A, He J., Dawson I (eds.) (2013) An Agroforestry guide for field

Yirefu T, Adugna B, Behailu B. Homegarden Plant use and their Traditional Management Practice in Bule Hora District, West Guji Zone, Southern Ethiopia. Agri Res& Tech: Open Access J. 2019; 21(4): 556168. DOI: 10.19080/ARTOAJ.2019.21.556168

Zomer RJ, Trabucco A, Coe R, Place F, van Noordwijk M, Xu JC. 2014. Trees on farms: an update and reanalysis of agroforestry's global extent and socio-ecological characteristics. Working Paper 179. Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program. DOI: 10.5716/ WP14064.PDF

Website

1. http://www.forestlivelihoods.org/wp-content/uploads/2016/12/Darko_Obiri_Beatrice_P.pdf
2. https://www.weadapt.org/sites/weadapt.org/files/legacy-new/knowledge-base/files/4e25a53a033e86C-VI-agroforestry-final-kenya.pdf
3. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1010&context=agroforestnotes
4. Introductory Agroforestry: Taungya System of Cultivation (iasri.res.in)
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=14511
6. http://apps.worldagroforestry.org/Units/Library/Books/Book%2006/html/6.2_some_imp_cr_i_rela_w_tree.htm?n=76

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