Natural Resources Conservation and Development

Level II

Learning Guide-44

Unit of Competence: Facilitate Agro-forestry Practices

Module Title: Facilitating Agro-forestry Practices

LG Code: AGR NRC2 LO3-LG-44

TTLM Code: AGR NRC2 M10 TTLM 0919v1

LO 3: Characterize traditional Agro forestry potentials

Instruction Sheet	Learning Guide #44

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

- Characterizing Agro forestry potentials
- Characterizing Agro forestry potentials based on farming practice

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

- Characterize Agro forestry potentials based on edaphic and climatic factors
- Characterize Agro forestry potentials based on farming practice site

Following up and evaluating Rehabilitation activity progress

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1and Sheet 2
4. Accomplish the “Self-check 1, and Self-check 2,” **in page -6, 8, and 10 ,** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1,” **in page -10.**
6. Do the “LAP test” **in page – 11** (if you are ready).

Information Sheet-1	Characterizing Agro forestry potentials

3.1. Characterizing Agro forestry potentials

3.1.1. Edaphic factors

The factors which relate to structure and composition of soil are called edaphic factors. Soil is very complex medium. A good fertile soil contains mineral matter (40%), organic matter (10%), water (15%) and air (25%). Mineral matter in the soil occurs in the form of particles. Soil can be studied under physical and chemical properties. Edaphic factors affect the organisms (bacteria, plant life etc.) that define certain types of ecosystems.

There was a technical committee for agroforestry in Ethiopia (1990) which was part of AFNETA (Agro forestry Network for Tropical Africa) established having its main focus to study potentials of agro forestry in the highlands (in this case areas having >1500 m.a.s.l.) .The emphasis given to those areas is due to the fact that this region is consisting 88% of the human and 2/3 of the livestock populations and, 95% of the cultivated lands in the country.

This committee classifies the highlands in to three main agro ecological zones. The main criteria considered are rainfall, altitude, and farming intensity.

1. High potential perennial zone (HPP)
   An ecological zone with warm, humid and length of growing period >240 days
2. High potential cereal zone (HPC)
   An ecological zone with intermediate climate and having length of growing period more than 180 days.
3. Low potential cereal zone (LPC)
   An ecological zone with high variability of rainfall, occasional drought and having length of growing period 90 – 150 days.
4. Agro-pastoral and Pastoral Dry lands (arid and semi-arid lands)

   This classification is based on the length of growing period (LGP) which is a function of such things as precipitation, evaporation, temperature and stored moisture in the soil. The farming system agro-ecological classification is a modern system of plant growth potential classification. It is classified on broader classification bases as shown in table 2.

3.1.2. Climatic factors

Generally speaking, our climate is defined by the complex interaction of all factors: the sun,

earth, sea, air, ice caps of earth, wildlife and other life forms. Many climate phenomenons disrupt the climate

Table 2. Main characterstics of Agro – Ecological Zone in the highlands

Agro ecological zones	HPP	HPC	LPC
Altitude range	<2500 >2500	< 2500 < 2500	< 2500 < 2500
Climate			
Rainfall (mm)	900-2000 bimodal	700 – 1500 uni/ bi	700 –1000 unimodal
T (mean Oc)	15- 20	10- 20	15-20 10- 20
Growing periods (days)	High humidity Mainly >240	Usually >180	high RF variability Occasional drought 90-150
Degradation	Limited	Moderate to sever	widespread, sere

Source D. Jirru, 1999

The country stands to benefit greatly from a widespread adoption of new agro forestry practices as well as re-enforcing and popularization of traditional agro forestry practices that are, for the most part, disappearing. Land degradation, largely from the HPC and LPC zones, is very severe because of the practice of removing crop residues, aftermath grazing, and removal of dung from the agricultural lands. Overgrazing is also common and very severe, especially in the low cereal zones. To a large extent agricultural practices have also failed to modernize and change despite the high population pressure, especially in the settled highlands (the HPP, HPC, LPC parts of the highly sedentarized drylands).

Self-Check -1	Written Test

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

1. What are the main criteria considered in agro ecological zone classification?: **(**3pts)
   _____
   _____
   _____
2. _____is an ecological zone with high variability of rainfall, occasional drought and having length of growing period 90 – 150 days.**(**3pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory – below 3points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
   _____
   _____

Information Sheet-2	Characterizing Agro forestry potentials based on farming practice

3.2. Characterizing Agro forestry potentials based on farming practice

The high potential perennial zone is characterized by warmer and more humid climate with a growing period of more than 240 days. Many distinct land use systems with agroforestry features were identified in this zone.

a) Enset – Coffee – Cereal – livestock system (in areas of 1500 – 2500 m.a.s.l.)

1. Hilly topography and intensive farming systems (labor and land) mostly found in Wolaita, Sidamo, Gedeo zones
2. Hilly, extensive farming systems found in areas of Wolkite, Jimma areas

b) Forest – Coffee – Enset – Livestock system (1500 – 2000 m.a.sl.)

3. Hilly, extensive farming systems found in areas of Jimma, Agaro, Bedele

c) Enset – Barely – Livestock system (2500 – 3000 m.a.s.l.)

4. Hilly, extensive farming systems in Gurage and Goffa highlands

Specific examples

Cereal/Enset/Livestock	Bale mountains
Enset/Coffee/Livestock	Sidamo Highlands
Enset/Cereal/Livestock	Butajira, Hosaena, Sodo
Enset/Root crop/Coffee/Maize	Wolaita Highlands
Enset/Livestock	Gurage Highlands
Coffee/Cereal/Livestock	Gofa Highlands
Coffee/Maize/Root crop/Enset	Kaffa Highlands
Coffee/Cereal/Livestock	West Highlands

2. In the High Potential Cereal zone (HPC)

The HPC zone can be characterized by an intermediate climate and usually with a growing period of more than 180 days. In this zone both crops and livestock production is important and the role of trees is minimal. Farmers tend to clear fell as they prepare land for agriculture as well as to meet wood fuel and timber requirement both for domestic and to sale as additional cash income. In this zone the role of cash crops such as fruits, coffee, chat etc. is minimal. Equally important is the lack of tree planting tradition in the zone. As a result, the farming systems do not have strong agro forestry elements. Trees and shrubs are gradually

disappearing from the agricultural landscape. The farming system in this zone is highly altitude dependent with (i) Mixed Barely/livestock system in the high altitudes and (ii) Mixed Cereal/livestock system in the mid-altitudes (1500-2300 m elevations). The following agro forestry systems are evident in the land use system, namely:

1. Scattered trees on agricultural lands (i.e. Acacia trees)
2. Scattered trees on grazing lands (i.e. Acaia, Croton, Cordia, Albizia, etc.)
3. Farm woodlots based on Taungya (i.e. Eucalypt woodlands)
4. Beekeeping vis-à-vis crop lands
5. Natural Fallow (not too short for tree regenertion)
6. Chat/food crops/livestock system (agriculture in Harar mid-lands)

Specific agro forestry systems in this zone and areas of practice

a) Mixed cereal – livestock system (1500 – 2500 m.a.s.l.)

7. Flat, intensive in areas of Rift Valley floor, parts of Arsi/Bale, Central plateau

8. Hilly, intensive farming systems in areas of Hararghe highlands, parts of central plateau, Bahir Dar, Mota

b) Barely – livestock farming system (2500 – 3000 m.a.s.l.)

9. Flat, intensive farming system in parts of Arsi/Bale areas
10. Flat intensive farming system in parts of central plateau, Addis Ababa, Debre Birhan)
11. Hilly, intensive farming systems in areas of Wollega, Debre Birhan, Debre Sina
12. Hilly, intensive farming system in Merto le Mariam area.

3. In Low Potential Cereal Zone (LPC)

The low potential cereal zone can be characterized by high rainfall variability and occasional drought and pest infestation (desert locust, armyworm, striga, weaver bird damages). The length of the growing period ranges from 90 to 150 days. This zone is further characterized by land degradation due to over cultivation, over grazing and deforestation. As a result, much of the ecology is man-made or induced by poor and bad farming practices without any use of agro forestry practices to protect the environment and maintain land productivity over the year. The two land use or farming systems of the HPC are also found here but the tree component has virtually disappeared from the land use system. Beekeeping or honey production is common but it is based on wild honey collection and not integrated with crop farming. The following agro forestry systems can be said to exist, namely:

1. Trees/shrubs on soil and water conservation structures (terraces)
2. Hillside afforestation with grass cut-and-carry
3. Chat/food crops (wollo and Bahir Dar area)

Specific agro forestry systems in this zone and areas of practice

a) Mixed cereal – Livestock system (1500 – 2500 m.a.s.l.)

13. Flat, intensive farming system in parts of Tigray, Wollo
14. Hilly, intensive farming system in areas of North Wollo

b) Barely – Livestock system (2500 – 3000 m.a.s.l.)

15. Hilly, intensive farming system in areas of Semien Mountain, North Gondar, Wollo.

4. In the agro pastoral and Pastoral zone

This zone is made up of areas below 1500-m altitude, except the lowlands of SW Ethiopia (i.e. Gambela, Beni-Shangul Gumuz and parts of the NW uplands of North Gondar Administrative zone. Rainfall is limited and the growing period is too short for most crops except those drought tolerant crops developed for short growing season. Next to livestock production the zone is noted for its gums and resins which are commercially exploited in some parts.

The potential for intensive agro forestry systems is low in the zone due to moisture limitation. However, the role of trees and lowland bamboos and reeds along riverine areas is important. Livestock production will however remain important productions system. Two major land use systems dominate this zone:

1. Agrisilvopasture (in the uplands), and
2. Silvopasture (in the more drier zones)

Land use systems with some features of agro forestry are the following:

1. Scattered trees in croplands
2. Scattered trees in grazing/range lands
3. Gum arabic woodlands with beekeeping
   Game parks/National parks

Some Traditional Agroforestry Practices in Ethiopia

Scattered trees in crop lands

This practice involves the growing of individual trees and shrubs in wide spaces in croplands. Dispersed trees grown in farmlands characterize a large part of the Ethiopian agricultural landscape. Trees would be grown in a scattered form over a crop field, usually between 1–20 trees per hectare to minimize impact on the companion crop. In such mixed intercropping, lopping and pollarding of trees would be practiced. Some good examples of this practice include Cordia Africana intercropping with maize in Bako and western Ethiopia; Acacia albida-based agroforestry in the Hararghe Highlands and Debrezeit.

The system has much potential for supplying fodder, poles, farm equipment, fuel wood, and agricultural improvements. Some possible research needs include soil-plant interactions, soil fertility and N-fixation studies on wide range of species, crop-tree yield studies and optimum

tree density, socioeconomic studies, and species selection and screening including seed tests, establishment, and management.

Home Gardens of the SNNP Region

Home gardens can be found in many parts of southern and southwestern regions of Ethiopia. Crops such as coffee, enset, pepper, and numerous kinds of vegetables are dominant components of the Ethiopian home gardens. Trees like Cordia Africana, Milletia fruginea, Albezzia gummifera, Ficus species, and Acacia species are among the species that form the upper storey of home gardens. The structural complexity in the Ethiopian home gardens is varied and ranges from complex and diverse forms containing numerous species and strata, as inSidama of the SNNPR, to the less complex forms, with one or two crop/tree mixtures, as in the Gurage enset home-compound farms.

Home gardens supply much of the basic needs of the local population and help reduce the environmental deterioration. The beauty and quality of the landscapes of Sidama, for example, stand in stark contrast to the treeless farmlands of much of Ethiopian agricultural lands. Multi-disciplinary biophysical studies, including soil-plant interactions and socioeconomic studies on home gardens, are needed for better understanding and use of these ecologically sound agroforestry systems.

Hedgerow intercropping

This form of agroforestry is practiced in many parts of Ethiopia. The sorghum/maize and chat (Catha edulis) hedgerow intercropping in the Hararghe Highlands of eastern Ethiopia is one such example. The shrub chat is a stimulant cash crop that generates cash for the farmer. Although the soil regenerative properties of the system are not obvious, it has undoubtedly helped in the soil conservation of the hilly landscapes of Hararghe.

Another form of hedgerow intercropping that has recently been introduced and has been widely tested in the scientific community is alley cropping. Alley cropping is an agroforestry technology suited to humid and sub-humid tropics and entails the growing of food crops between hedgerows of planted shrubs and trees, preferably leguminous species. The hedges are pruned periodically during the crops' growth to provide biomass and enhance soil nutrient status. There is great potential for use of the system in Ethiopia, particularly to improve soil and water conservation in the hilly and mountain ranges for which Ethiopia is known.

Riparian zone vegetation

There are numerous perennial and intermittent rivers in Ethiopia. Some of these rivers and streams do support large numbers of species in relatively dense vegetation, which to the onlooker gives the appearance of a seemingly unbroken canopy cover. A case in point is the vegetation along the Awash and Eliwoha waterways, which contains diverse and multi-layeredspecies.The most common riparian species along these rivers are Acacia tortilis, A. nilotica, Balanites aegyptica, Tamarindus indica, Tamarix spp., and Ziziphus spp.

The riparian vegetation is an important source of fodder for livestock during the dry season, and is a source of food for humans, medicinal plants, fuel wood, and wood for utensils. It is also home to many bird species and other wild animals. Pastoral people along the Awash River, for example, often rely heavily on gathered foods from these forests along waterways. The riparian woodlands also contain numerous brow sable fodder and shrub species that produce dry-season fodder. The Afar nomads protect and highly revere these wooded lands.

Enclosures and natural regeneration of species in woodlands and pasture

The establishment of enclosures will be a realistic and cheap approach to the improvement of pastoral and degraded woodlands in Ethiopia. The single most important approach to improve the woodlands and pastures is to establish enclosures and provide protection against grazing and tree felling. Once this is done, trees and grasses will often regenerate quickly and grow without intervention. Examples of successful enclosures in Ethiopia include those undertaken by the Tigray Regional Government on a large part of the inhospitable Tigray Terrains, and enclosures established by Self Help International (SHI), Ireland, in the dry lands of the Rift Valley of southern Showa.

Wherever enclosures were established, the impact on regeneration has been substantial. The enclosures were established with the consent and involvement of the local community. Research needs include testing the effectiveness of enclosures under various plant communities, adoption and scaling up, socioeconomic studies,

Banana based multistory garden

Various fruit species are integrated in to banana garden to diversify and maximize food and cash crop production. The practice is locally designated as *yeguwaro atiklit*, the term that denotes various homegarden crops. This multistory agroforestry system is also practice in open field farthest away from homegarden. Establishing the practice in open fields commences with clearing the existing vegetation and ploughing. Maize crops are sown after the soil loosened to the desired tilts. Wide pits are dug 2 days later at a spacing of 1.5 to 2m

and planted with banana. Young banana planted grow along with the maize crop during the first cropping season. In successive years various fruit species, commonly avocado and mango, are planted between banana clumps. After the fruit trees mature, all nearby banana clumps likely to be smothered by tree canopies are removed. Moringa represents another important feature of this agroforestry practice. Although sparse, it is grown in almost all farms, both for its food and for its medicinal and wood products.

Self-Check -2	Written Test

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

1. Write the Characteristics of Agroforestry Species (3pts)
2. What is the management practice you recommend on scattered trees in crop lands? (3pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____.

2. _____

_____

_____

Operation Sheet 1	Identify Agro forestry species

Objective To know agro forestry species

To know characteristics of AF

Materials, tools and equipment: Paper, pen note pad

Procedure:

- Wear safety cloths
- Surveying the environment
- Contact the households exercising the system, manual of plant identification
- Record data
- Identify the characteristics of AF species

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 Agro forestry species

Reference:

Azene Bekele Tesemma. 1993. Useful Trees and Shirubs for Ethiopia. Identification, Propagation and Management for Agricultural and Pastoral communities.

_____.2009. Training, Teaching and Learning Material (TTLM) on Applying Farm forestry Techniques for Natural Resource Development Technique, Soddo

Bashir Jama, Abednego Kiwia and Annah Njui. 2004. Market-oriented agroforestry: options and strategies for their dissemination in East and Central Africa. World Agroforestry Centre (ICRAF), Nairobi

Dechasa Jiru. 2006. Agro-forestry Training Manual. SUSTAINABLE LAND USE FORUM (SLUF) Part 2: Methods and Techniques for Improved Land Use (Unpublished)

Nair, P.K.R. 1993. An introduction to Agroforestry. Kluwer Academic Publishers, The Netherlands.

Young, A. 2002. Agroforestry for Soil Management. 2nd Edtion. CAB International, UK

Baumer, M. 1990. Agroforestry and Desertification. The Neatherlands.

FAO. 1978. Forestry for Local Community Development. FAO, Forestry Paper 7. FAO, Rome

Samra, J. and H. Eswaran (2000). Challenges in ecosystem management in watershed context in Asia. In:Lal, R.(Ed.) Integrated Watershed management in the global ecosystem. New York: CRS press

Surash, R. (2002). Soil and water conservation Engineering. New Delhi: standard publisher.