**Natural Resources Conservation and Development**

**Level II**

# Learning Guide-36

**Unit of Competence:** **Participate in Rehabilitation and Restoration of Degraded Areas**

**Module Title:** **Participating in Rehabilitation and Restoration of Degraded Areas**

**LG Code:** **AGR NRC2 LO3-LG-36**

**TTLM Code:** **AGR NRC2 M08 TTLM 0919v1**

**LO 3:** **Implement rehabilitation and restoration activities**

| Instruction Sheet | Learning Guide #36 |
|---|---|

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

- Analyzing sample soil for Seed bank
- Identifying existing species to restore degraded area
- Selecting potential species
- Planning best type and species of trees for afforestation
- Enhancing community participation to rehabilitation activity
- Following up and evaluating Rehabilitation activity progress

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**:

- Analyze sample soil for Seed bank
- Identify existing species to restore degraded area
- Select potential species
- Plan best type and species of trees for afforestation
- Enhance community participation to rehabilitation activity

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 1, Sheet 2, Sheet 3, Sheet 4 Sheet 5 and Sheet 6. ”
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 Self-check 4 Self-check 5 and Self-check 6” **in page -1, 6, 8 , 10, 16 and 18** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2, Operation Sheet 3 and Operation Sheet 4 ” **in page -19 ,20.**
6. Do the “LAP test” **in page – 20** (if you are ready).

| Information Sheet-1 | Analyzing sample soil for Seed bank |
|---|---|

## 3.1. Analyzing sample soil for Seed bank

The first consideration for any information involving environmental analytical data is whether the samples adequately represent the site being investigated. The purpose of environmental sampling and analysis is to obtain a small but informative portion of the sampling site media being investigated. Seldom is the entire site collected for analysis. There are almost infinite soil samples that could be taken in most situations. Therefore, soil samples that are intended to be "representative" of a site are analyzed and conclusions about that entire site are made based on the data obtained from them. It is now clear that most of the important and large costs involving decisions are based on the sampling data, making it essential that these data accurately characterize the conditions of the actual site.

The primary aim of representative soil sampling is to get accurate data about the soil quality of a specific site but the ultimate objective is to know the soil characteristics of the area and implement rehabilitation and restoration.

| Self-Check -1 | Written Test |
|---|---|

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page: 2 pts each choice question

1. *What is the primary objective of soil sampling,?* (3 pts)

***Note:*** **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

**1.** _____

| Information Sheet-2 | Identifying existing species to restore degraded area |
|---|---|

## 3.2. Identifying existing species to restore degraded area

Biological intervention refers to the use of versatile plant species (Single/combination of species) such that it can overcome many if not most of the problems confronting the restoration of degraded areas. The species must have the following characteristics:

- Ability to survive, adapt and grow normally under harsh condition;
- Ability to grow at extremely low/high pH levels;
- Potential to grow fast/ increase its biomass;
- Tolerate drought and fire;
- nitrogen-fixing and/or mycorrhizal associations (bioremediation potential);
- Resistance to pests and diseases;
- Potential to reproduce even under adverse environment;
- Ability to phytoremediate (remove toxic heavy metals from the mine waste areas).

The species should also possess other environmental functions. The so-called bio-engineering strategy combines vegetative and engineering schemes i.e. planting of certain species or mix of different plant forms in a methodical manner to provide structural cover for erosion control, slope stabilization and enhanced drainage system.

### 3.2.1. Soil seed bank test mechanisms

Soil seed banks of orchids are presumed to be present at population sites (Curtis, 1943; ) High a symbiotic germination is another way to “test” for seed viability form the foundation of rational and integrated methods of weed management. Species of the soil seed bank showed greater compositional similarity density, we wanted to test these hypotheses proposed for seed bank characteristics under Methods for seedling emergence followed van der Valk and Davis (1978). Risk assessments of gene flow are usually very limited in time and space. Large-scale studies of genetically modified crop plants, for example, are seldom studied epidemiologically. That is, they are not studied at the same temporal or **spatial scales** as they are actually grown (often greenhouse or test plot scales). This greatly limits their usefulness in application, since the processes at work may miss important synergistic, antagonistic, and chaotic outcomes, which can occur in agricultural and other ecosystems.

For example, experiments do not allow much certainty in how genetic material may integrate, persist, and be dispersed.

### 3.2.1. Toxic species for environment

Although the majority of phytoplankton are harmless to humans, some contain toxins that can cause illness and even death in extreme cases through the consumption of contaminated food

Organisms can be exposed to various kinds of toxicants at any life cycle stage, some of which are more sensitive than others. Toxicity can also vary with the organism's placement within its food web. Bioaccumulation occurs when an organism stores toxicants in fatty tissues, which may eventually establish a trophic cascade and the biomagnification of specific toxicants. Biodegradation releases carbon dioxide and water as by-products into the environment. This process is typically limited in areas affected by environmental toxicants.

Harmful effects of such chemical and biological agents as toxicants from pollutants, insecticides, pesticides, and fertilizers can affect an organism and its community by reducing its species diversity and abundance. Such changes in population dynamics affect the ecosystem by reducing its productivity and stability.

Although legislation implemented since the early 1970s had intended to minimize harmful effects of environmental toxicants upon all species, McCarty (2013[4]) has warned that "longstanding limitations in the implementation of the simple conceptual model that is the basis of current aquatic toxicity testing protocols" may lead to an impending environmental toxicology "dark age"

The most known or common types of heavy metals include zinc, arsenic, copper, lead, nickel, chromium and cadmium. All of these types cause certain risks on human and environment health.

Though certain amount of these metals can actually have an important role in, for example, maintaining certain biochemical and physiological, "functions in living organisms when in very low concentrations, however they become noxious when they exceed certain threshold concentrations."[15] Heavy metal are a huge part tof environmental pollutions and their toxicity "is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons.

.

| Self-Check -2 | Written Test |
|---|---|

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

1. What is the Characteristics of identified existing species to restore degraded area (3 pts)
2. What is the effect of toxic species for environment? (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.** _____

_____.

| Information Sheet-3 | Selecting potential species |
|---|---|

3.3. Selecting potential species

Indigenous or other selected species is used in the demarcated area to rehabilitate degraded woodlands and provide alternative sources of fuel wood and income for the communities. Vegetative measures are first choice because they are rather cheap materials, i.e more or less four times cheaper engineering structures.

The basic considerations in the selection of tree species as bio-engineering measure against soil erosion and landslides are as follows:

- Plants must grow quickly to establish ground cover, have dense rooting systems and canopies.
- Roots and aboveground parts should grow rapidly in order to provide the required protection as soon as possible (rapid lateral growth of stems, leaves and roots for erosion control)
- Plant should possess deep and wide root system for good anchorage in the subsoil. A dense shallow root system can also be used because of the matting effect
- Rapid and dense growth of roots vertically for shallow-seated slope stabilization
- High root tensile strength and surface roughness for soil reinforcement
- Plant should produce a large volume of litter to improve the site. Legumes, in particular, can add considerable amount of nitrogen to the soil through symbiosis with nitrogen-fixing bacteria
- Prevent or minimize further transport of eroding materials
- Plant should form dense and wide spreading crowns or interlocking canopy as early as possible.
- Ability to be propagated vegetatively/asexually as large section cuttings as used in brush layering and as large diameter live poles.

Potential key plant species for restoration or rehabilitation

- native species - to enhance biodiversity
- rare or threatened species - to increase their populations
- fast-growing species - to occupy site and exclude weeds
- species tolerant of poor soils - to facilitate rehabilitation
- nitrogen-fixing species - to improve soil fertility
- fire tolerant trees - to use in fire-prone landscapes, create new forests or form buffers around a restored forests

Some situations might require a two-stage approach, with stage one using tolerant, exotic species to modify the site, and facilitating the recolonization of native species in stage two. For example, the site fertility might be enhanced using a short-lived, exotic, nitrogen fixer that eventually enables native species to be re-introduced.

Or a saline water table might be lowered using a salt-tolerant exotic species able to transpire large amounts of water. Once the adverse site conditions were ameliorated, native species could be replanted. These more complex approaches invariably require more physical and financial resources as well as a detailed understanding of the ecological processes involved.

| Self-Check -3 | Written Test |
|---|---|

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page: 2 pts each choice question

**Match Column "B" with Column "A" (2 points each)**

| A | B |
|---|---|
| 1. native species | A. to occupy site and exclude weeds |
| 2. rare or threatened species | B. to increase their populations |
| 3. fast-growing species | C. to enhance biodiversity |
| 4. species tolerant of poor soils | D. to improve soil fertility |
| 5. nitrogen-fixing species | E. to facilitate rehabilitation |
| 6. fire tolerant trees | F. to use in fire-prone landscapes, create new forests |

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

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

**1.** _____ **4.** _____

**2.** _____ **5.** _____

**3.** _____ **6.** _____

| Information Sheet-4 | Planning best type and species of trees for afforestation |
|---|---|

## 3.4. Planning best type and species of trees for afforestation

Forests can be created in different ways. An exiting forest reproduces itself naturally, from seedlings or sprouts by vegetative propagation. This is called natural regeneration. Forests can also be established by artificial regeneration, either by planting (using seedlings) or by direct seeding (sowing). **Afforestation** is forest created on bare land where there have not been forests for at least 50 years; e.g. afforestation of grass lands.

**Planning and selecting species**

For planting seedlings on bare land the primary activities will be collecting materials, preparing seedlings, clearing the site and layout area.

**Digging the holes** Hoe an area of about 1 square meter around the planting holes. The area should be cleared of all vegetation to eliminate competition for nutrients and water.

For containerized forest trees the holes should be about 20-40 centimeters in diameter and slightly deeper than the length of the container. For fruit trees the hole should be larger (up to 60 x 60 x 60 cm). The harsher the site, the deeper the holes should be.

For bare-rooted seedlings make sure that the hole is deep enough to allow the taproot to hang down vertically without bending its tip.

Pile the soil on the sides of the hole without scattering it too much. Loosen, if necessary with a pickaxe, the bottom of the hole to make it easier for the plant roots to penetrate the soil.

On favorable sites small bare-rooted seedlings and cuttings may also be planted by just making a slot with a planting hoe

- Distribution of the seedling to planting site. The supply of plants should be arranged so that planting is never held up for lack of plants. At the same time, the number of plants kept in temporary storage near the work site should be as small as possible.
- Carrying out planting

Planting containerized seedlings When planting containerized seedlings, fill topsoil back into the hole until the hole is as deep as the container. Cut the container open with a knife or the edge of the hoe and remove the bag. Care should be taken not to break up the earthball.

Firm the soil carefully with your hands or with your heel. Do not leave air pockets around the ball or the plant will dry out and die. Check that the firming is sufficient by gently pulling the plant. The plant should rest firmly in the ground.

| Self-Check -4 | Written Test |
|---|---|

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page: 2 pts each choice question

1. *What* is afforestation? (3 pts)

***Note:*** **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

**1.** _____

| Information Sheet-5 | Enhancing community participation to rehabilitation activity |
|---|---|

3.1. Enhancing community participation to rehabilitation activity

3.5.1 Implementing sustainable basis of the work plan.

Participation is given highest priority at all levels and involving all stakeholders in planning, implementation and benefit-sharing of rehabilitation. Forest rehabilitation projects should be participatory designed, with the involvement of all relevant stakeholders and experienced experts in degraded land rehabilitation.

• Participatory planning is essential to successful project implementation. Participatory processes should be adopted in project planning and implementation to ensure increased local support and project sustainability;

• Community participation and empowerment through training and awareness creation in adoption of sound land use practices and capacity building.

The communities formulate local rules and regulations based on traditional norms and values to manage the demarcated areas. The rules and regulations encompassed access to land, rights and responsibilities, bushfire management, harvesting of trees, species protection and unauthorized encroachment and as a result the vegetation in the forest has increased.

• Empowerment of local communities for effective participation in rehabilitation requires the fulfillment of several conditions, including:

a. A functional institutional framework at village level to oversee planning, implementation and monitoring;
b. Capacity building of communities to enable them implement projects; and
c. Equitable sharing of costs and benefits within communities and between them and government to give the communities a sense of ownership

### 3.5.2. Implementing rehabilitation and restoration

This section reviews rehabilitation techniques which are being used in the agricultural and forest sectors.

- ✓ **Natural Regeneration**

Natural regeneration involves deliberately protecting degraded land to enhance and accelerate the natural processes of forest succession in order to re-establish a healthy and resilient productive – generally a forest – ecosystem. Where land is suited to direct human use and has not been stripped of topsoil, substantial recovery may be achieved in as few as 3 to 5 years but more typically may take 20 years.

This technique is simple and cheap.

Disadvantages:

- Uncontrolled grazing can have a major influence.

- When land has been degraded for a long period, natural processes are often disturbed and barriers are formed which block the natural pathways of forest succession. These barriers include: low availability of native seeds and other propagules on-site, seed and seedling predation, seasonal drought, root competition, and poor soil conditions. Natural regeneration can be used in all ecological zones. However, as earlier mentioned, the degree of success depends on the ecological characteristics of each specific site.

✓ **Assisted Natural Regeneration**

An alternative approach to the restoration of degraded lands is to accelerate regeneration by assisting the natural processes of succession. Assisted natural regeneration (ANR) involves: cutting or pressing down the weeds around existing naturally established seedlings, protecting the area from fire, area closures etc. ANR differs from 'natural regeneration', as it allows some human intervention but generally precludes tree planting. For example, in Wukro Woreda, in north eastern Ethiopia, enclosures have been used as a tool for rehabilitating degraded lands.

As with natural regeneration, ANR is also simple and cheap to implement. However, it is important to know what specific factors limit the rate of regeneration of trees in deforested areas, so that minimum input strategies may be devised to overcome them.

- ***Area closure***

  - Area closure is a very low input conservation measure because the only thing that is practice is to prohibit livestock & human interference.
  - It is a passive restoration when no action is taken except to cease environmental stressors such as agriculture or grazing.
  - The main objective is to improve the ground vegetation cover of degraded land by natural regeneration
  - There is no tree plantation what is done is to close the area from 3 to 5 years until 80% of the natural vegetation attain.
  - In need a very tight willingness of the community for its effectiveness.
  - After the natural vegetation attain 80% it is possible to use with proper management.
  - If the enclosure diversity is very low enrichment plantation is possible but the species should be more of local rather than exotic.
  - Mostly this is a good conservation for marginal lands.

✓ **Enrichment Planting**

Enrichment planting is defined as the introduction of valuable species to degraded forests without the elimination of valuable individuals already present. The technique includes: line-, strip-, gap- and under- planting. Enrichment planting practice is intermediate in intensity

between natural regeneration and plantations. This technique has been suggested for restoration of over-exploited primary and secondary forests as it can increase total tree volume and the economic value of forests. In addition, there are biological, environmental and economic arguments in favour of enrichment planting.

When compared to other artificial regeneration systems, enrichment planting has the advantages of mimicking natural gap dynamics and protecting the soil by maintaining vegetative cover on site. Although enrichment planting is mainly used in the humid zone for production of timber, it has potential for application in other ecological zones.

The main constraints for the application of this technique include: difficulty in selection of appropriate species and/or a lack of adherence to sound planting and tending practices. Others include: insufficient over storey opening prior to planting, insufficient follow-up tending, pest attacks, labour demand and high costs of establishment and maintenance of planting in the initial years.

- ✓ **Plantations**
  - **Direct seeding and**
  - **Seedling planting**

This technique involves planting trees and/or shrubs as single or mixed species on degraded lands. There is increasing evidence that mixed-species plantations are more effective for rehabilitation than the use of single-species plantations due to their high potential for biomass production and attraction to animal seed dispersers as well as increased soil fertility and soil microbiological activity (Vanclay 1994, Parotta 1999). The inclusion of promising indigenous tree species along with exotic species would further improve the ecological stability and sustainability of forest plantations (Yirdaw 2002). Mixed forest plantations, therefore, should be given serious consideration in the planning and establishment of rehabilitation programmes.

Major considerations in the use of plantations for rehabilitation include:

- Careful and accurate species/site matching.
- Choice of complementary species in case of mixed species plantations.
- Critical timing of forest management interventions.
- Provision of adequate protection against fire and grazing especially in the savannah and drylands.

- ✓ **Land Rehabilitation Using Agroforestry**

Trees may be grown in farmer's field while crops are grown in the under storey. The trees might be dispersed widely or spaced systematically. The practice of raising trees dispersed on cropland may be based on protection and management of existing trees or it may involve planting of new trees.

- ✓ In many drier parts of Ethiopia this kind of agroforestry is common. Species commonly used for this purpose is *Acacia albida, Balanites aegyptica* and *Croton machrostachys* in higher altitudes and rainfall areas. Even exotic species such as *Leucocephala, Sesbania sesban*, *Grevillae robusta* and *Calliandra calothyrsus* can be used for this purpose in the higher rainfall areas. An advantage of this system is that, these trees produce leaves during dry season, which can be used as livestock fodder. In addition they pump up nutrients such as phosphorus from deeper layers of the soil. Through their nitrogen fixation capacity they improve the soil fertility and growth performance of most crop species especially that of sorghum and maize. However it is important that the trees are regularly managed through pruning, lopping, pollarding or coppicing before the growth season of the crops.

Reclamation agroforestry involves two stages. In the first stage, tree and/or shrub species are introduced on to degraded forestland together with any necessary mycorrhizal or rhizobial symbionts, with the objective of checking erosion and restoring soil organic matter and fertility status.

In the second stage, the cover may be selectively removed and agricultural production introduced. However, time is needed to build-up the enlarged plant-litter-soil nutrient cycle, a period during which exploitation of the vegetative biomass should be kept low with necessary protection from grazing etc. The initial tree removal can be along contour aligned strips, with belts of trees remaining in between, leading by stages towards hedgerow intercropping (Young, 1989, 1995). Other options include fodder incorporation along strips or multi-storey systems (Young, 1989, 1995).

- ✓ **Soil and Water Conservation**

Soil and water conservation techniques entail creating structures which improve the retention of water for plant growth. These techniques are more suitable for the dry sub-humid and dry land areas, which experience severe moisture deficits. The techniques are, however, generally labour-intensive.

**CONTROL MEASURES**

Soil conservation measures can be grouped as follows:

- Biological/agronomic
- Physical/mechanical

Biological /Agronomic SWC techniques

Biological soil conservation can be defined as a set of conservation practices, which by the adequate cover of the soil surface, the recirculation of organic matter and nutrient, as well as the establishment of vegetative barrier across the slope, prevent soil moisture loss, improve soil properties and maintain ( restore) the productivity and stability of the agro ecosystem. Wherever possible, biological conservation measures must be interacted with physical structures and mutually benefit one from the other. In general it can be called as conservation farming which can improve the stability, productivity, sustainability and equitability of cropping systems in dry lands. It includes several practices aimed at improved vegetation cover and improved soil structure for erosion control.

1. **Contouring /contour farming or contour ploughing**:- is the method of applying agricultural practices (tillage, seeding - - -) along the contour (across the slope) rather than up and down slopes.

2. **Strip cropping**:- is a cropping practice where strip of forage and food crops are alternately established or it is a system of establishing more than one crop in alternate strips( E.g. Row crops: erosion permitting crops, are alternately planted with close growing crops : erosion permitting crops ) following certain pattern for definite purpose.

3. **Tillage Practice /Zero tillage**

4. **Mechanical soil and water conservation measures**

- ✓ Bunds
- ✓ Terraces
- ✓ Trenches
- ✓ Ditches

<u>Common soil conservation practices for cultivated land</u>

A risk of erosion exists on a cultivated land from the time trees, bushes and grass are removed.

A risk of erosion on cultivated land occurs by:

-using too steep slopes for cultivation/farming
-cultivating up and down the slope
-continuous use of land for the same crop without fallow or rotation
-inadequate fertility and organic content

Conservation strategies are aimed at establishing and maintaining good ground cover. If the various mechanical protection structures are designed properly, they can effectively check runoff unless they are overtopped and broken. But soil conservation relies strongly on agronomic methods combined with soil management while mechanical measures play a supporting role.

Soil conservation practices on cultivated land include:

| Agronomic_practices | soil_management | Mechanical |
|---|---|---|
| – Organic content improvement<br>– multiple cropping<br>– cover cropping<br>– strip cropping<br>– crop rotation<br>– grass strip<br>– contour farming<br>– mulching | – conservation tillage<br>– land classification for efficient utilization of farm resources | – Terraces<br>– waterways<br>– cutoff drain |

| **Self-Check -5** | **Written Test** |
|---|---|

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

1. _____is given highest priority at all levels and involving all stakeholders in planning, implementation and benefit-sharing of rehabilitation (3 pts)
2. _____is defined as the introduction of valuable species to degraded forests without the elimination of valuable individuals already present. (2points)
3. _____is a very low input conservation measure because the only thing that is practice is to prohibit livestock & human interference. (2points)
4. List some agronomic and mechanical practice of soil and water conservation. (5points)

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

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

**Answer Sheet**

| Score = _____ |
| --- |
| Rating: _____ |

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____
   _____
   _____

| **Information Sheet-6** | Following up and evaluating Rehabilitation activity progress |
| --- | --- |

3.6. Following up and evaluating Rehabilitation activity progress

Rehabilitation activities are preceded by stakeholder consultation to enhance awareness of the causes and consequences of land degradation and of the available techniques for rehabilitation and their benefits.

Rehabilitation efforts must be preceded by the collection of baseline data on biophysical and socioeconomic conditions, followed by monitoring of these aspects during the rehabilitation process.

The Environmental Rehabilitation process should form an integral part of site and construction activities. The rehabilitation specialist should therefore be appointed, and on-site at the project construction inception. The Rehabilitation Specialist would form an integral part of the project team, attending regular project site meetings, receiving project meeting Minutes and being kept fully updated regarding the Construction Programme timeframes and Construction Works sites.

| Self-Check -6 | Written Test |
|---|---|

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

1. *W*hat is the importance of follow up?*?* (3 pts)

***Note:*** **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

**1.** _____

| Operation Sheet 1 | Select species for rehabilitation |
|---|---|

Select species for rehabilitation

Steps

- Collect all necessary information of agro ecology
- Divide the field into different homogenous units based on the visual observation and farmer's experience.
- Match species with the field.
- Record identified species.

| Operation Sheet 2 | Conduct Area closure |
|---|---|

Conduct Area closure

Steps

- Collect all necessary materials and tools.
- Identify degraded/affected area by surveying
- Fencing (live fence, wire)
- Apply passive and active activities of restoration.
- Monitor area closure.

| Operation Sheet 3 | Enrichment plant |
|---|---|

Enrichment plant

Steps

- Identify died seedling in area closure
- Dig hole for planting seedlings
- Keep it at least for two weeks.
- Plant seedlings in pit prepared.
- Prepare report number of seedlings you plant
-

| Operation Sheet 4 | Construct bund |
|---|---|

Construct bund

Steps

- Select site
- Prepare materials and tools
- Measure the slope of selected site
- Decide spacing between two bunds based on slope of land.
- Lay out and peg bunds at 0.05-1% on high rain fall and 0% at low rain fall area.
- Dig channel and manage the soil removed from channel
- Check the work
- Prepare report

| 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-** Select species for rehabilitation

**Task 2-** Conduct Area closure

**Task 3-** Enrichment plant

**Task 4-** Construct bund

## Reference:


**https://www.youtube.com/watch?v=XOdPJDSTvjM**

**Smith, K., 1996, Environmental Hazards. Assessing Risk and Reducing Disaster. Routledge, London.**

https://www.slideshare.net/RochelleNato/lesson-1-use-of-farm-tools-and-equipment

McCarty LS (December 2013). "Are we in the dark ages of environmental toxicology?". *Regulatory Toxicology and Pharmacology*. **67** (3): 321–4.