

Natural Resources Conservation and Development

Level – II

Based on March 2022, Version II Occupational standard



Module Title: - Rehabilitating and Restore Degraded Areas

LG Code: AGR NRC2 M03 LO (1-4) LG (10-13)

TTLM Code: AGR NRC2 TTLM 0922v1

September, 2022
Addis Ababa, Ethiopia



Table of Contents

Introduction to the Module	1
LO #1- Prepare for rehabilitation of degraded area.....	2
Instruction sheet	2
Information Sheet 1	4
Self-check 1	17
LO #2- Demarcate area to be rehabilitated	18
Instruction sheet	18
Information Sheet 2	19
Self-Check – 2	29
Operation Sheet -2.....	30
LAP TEST-2	33
LO #3- Implement rehabilitation and restoration activities	34
Instruction sheet.....	34
Information Sheet 3	35
Self-Check – 3	53
Operation Sheet 3	54
LAP TEST-3	55
LO #4-Document and report information	56
Instruction sheet	56
Information Sheet 4	57
Self-check 4.....	3
Reference.....	4

Introduction to the Module

This module covers knowledge, skills and attitude required to demarcate and Implement of rehabilitation and restoration of degraded areas.

Page 1 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

LG #10

LO #1- Prepare for rehabilitation of degraded area

2.1.1 Instruction sheet

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

- Introduction to the module
- Gathering baseline information
- Identifying, assessing and reporting OHS hazards and risks
- Identifying environmental implications of rehabilitation and restoration works
- Selecting and preparing natural area restoration tools, equipment and machinery
- Carrying out pre-operational checks on tools, equipment and machinery
- Selecting and using suitable safety and personal protective equipment (PPE)

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:

- Introduction to the module
- Gather baseline information
- Identify, assess and report OHS hazards and risks
- Identify environmental implications of rehabilitation and restoration works
- Select and prepare natural area restoration tools, equipment and machinery
- Carry out pre-operational checks on tools, equipment and machinery
- Select and use suitable safety and personal protective equipment (PPE)



Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1

1.1 Identifying, assessing and reporting OHS hazards and risks

1.1.1 Gathering baseline information

Baseline information is refers to collection of baseline information on biophysical. It refers to collection of baseline information on biophysical, social and economic aspects of a rehabilitation area. Rehabilitation is seen as the most viable way of mitigating the effects of land degradation. “Rehabilitation” defined as an act of improvement from a degraded state. Degradation of land is caused by biotic and abiotic pressures. An ever increasing population places enormous demand on land resources. These pressures have led to drastic changes in the proportion of land utilized for agricultural activities, urbanization and industrial development.

Land degradation has a direct bearing on the productivity of soil, its vulnerability to rainfall variations, scarcity of drinking water, fodder and fuel wood. Given the interlinkages of crop production, livestock economy and environment, land degradation has a major impact on the livelihoods of the people, especially in rural areas. The time it takes to achieve the objectives of rehabilitation at a particular site will vary; some are likely to be relatively quick while others may last beyond a human lifetime.

In the case of ecological restoration, several preconditions must be met before recovery is possible, irrespective of the method used. Only then may it be feasible to attempt restoration. A key issue is deciding how much intervention is needed beyond simply protecting the site from further disturbances; that is, how many species must be deliberately brought to the site and how many can be relied upon to colonize unaided? These biophysical changes have both social and economic impacts, with the most immediate effects being felt by communities that depend on forests for part or their entire livelihood. Forest resources provide food, medicines and firewood, resources that now have to be obtained from more distant forests. And as forest areas are reduced pressure on the remaining forests increases even more.

Baseline studies are fundamental tools for measuring success or failure (for monitoring flora and fauna changes over time and the impact of rehabilitation on the livelihoods of people). Therefore, ensuring the collection of baseline data on the biophysical and socio economic conditions is necessary to rehabilitate the degraded area.

Page 4 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

In participation of rehabilitation of degraded areas there may be different hazards will occur. One way to classify the hazard is to think about how likely it is that an injury may occur. People often use the terms hazard and risk interchangeably, but they are not the same. Hazard means a thing or condition that may expose a person to a risk of injury or occupational disease. Risk means a likelihood of injury or occupational disease.

Occupational Health and Safety (OHS): Any occurrence which results in personal injury, disease or death, or property damage. OHS is a discipline dealing with the prevention of work-related injuries and diseases as well as the protection and promotion of the health of workers.

Risk is the significance of the hazard in terms of likelihood and severity of any possible injury.

Safety is the provision and control of work environment systems and human behavior which together give relative freedom from those conditions and circumstances which can cause personal injury, disease or death, or property damage. Hazardous Substances Any substance that has the potential to harm the health of persons in the workplace and includes chemicals scheduled under the Poisons Act, chemicals classified under the Dangerous Goods Act (1975) or Hazardous Wastes.

Forest fire incidence: Forest fires prediction combines weather factors, terrain, dryness of flammable items, factors to derive forest fire incident in a logistical regression model, and built a forest fire ignition probability model.

Factors that influence the degree of risk include:

- The type of exposure, and
- The length of time of exposure to the hazard

1.1.2 The benefits of assessing and managing risks

The effective systematic management of *risks* improves worker health and safety, as well as productivity.

Eliminating and controlling *risks* in the workplace helps to:

- prevent and reduce the number and severity of workplace injuries, illnesses and associated costs
- promote and improve worker health, wellbeing and capacity to work, and
- Helps to foster innovation and improve quality and productivity of work.

In conclusion, it is necessary to tie loose ends together and to differentiate hazards, damage, and risk and risk management:

- (1) **Hazards** are defined as "naturally occurring or human-induced process (s) or event(s) with the potential to create loss, i.e. a general resource of danger".
- (2) Environmental and socio-political processes may result in detrimental changes in an individual's and household's assets. While these changes do not result in easily noticeable losses they result in vulnerability increasing the chance that future hazards have a disastrous impact.
- (3) Damage results from hazards and is defined as any negative impact on assets and/or the well-being of individuals and groups. Damage is often unevenly spread within one population. The extent of damage is not only dependent on the severity of the hazard but also on the vulnerability of the household.
- (4) Hazards and the related damage are unpredictable. The culturally and socially embedded perception of this unpredictability is called uncertainty.
- (5) Risk relates to an unpredictable or hardly predictable event which has consequences that are perceived negatively. Risks are the culturally and socially embedded perceptions of future possible damage. Risks are neither directly observable nor are they directly measurable.
- (6) Risk minimization is always based on the culturally and socially embedded assessments and perceptions of past and future damage. The analysis of prior personal experiences or consensus based models is always a necessary first step for developing risk minimizing strategies. Risk minimization may be based on conscious decisions or may be embedded in custom and refers to (a) attempts at eliminating the occurrence of negatively evaluated events and (b) to strategies to decrease vulnerability and (c) to limiting the impact of damage once it has occurred.

In order to prioritize ecosystem services for conservation or restoration, it is necessary to know in which areas natural habitats have more potential to decrease exposure to flooding and erosion from sealevel rise (SLR) and storm surges. This can provide placebased information of where the natural habitats shield susceptible populations from streams and flooding.

A hazard is anything that has the potential to harm the health or safety of a person and in the case of dangerous goods, includes damage to property.

OHS hazard in rehabilitation of degraded area work place include heavy materials and equipment, slippery or uneven surfaces, moving machinery and vehicles, solar radiation, and potential dangers from handling potting media, fertilizers, watering systems, and spider and insect bites.

The workplace needs to be free from these hazards, therefore all persons on a daily basis when walking and working around the property, need to be on the lookout for potential hazards and report it.

1.2 Identifying environmental implications of rehabilitation and restoration works

1.2.1 Environmental Rehabilitation

Environmental Rehabilitation means restoration and reversal of annihilable or degradable environment back to better states and to ample ecosystem. Agriculture is the major economic activity and the wellbeing of the peoples in Ethiopia. Though it is the major activity however, its ability to satisfy the need of the population has shown either stagnation or a very slow growth rate during the last three decade.

The countries chronic food insecurity problem is the result of cumulative effects of varies factors that have been increasing in magnitude over many years. Some of the major factors contributing to the current food insecurity include:

- Widening gap between the level of food production and the rapid population growth.
- Degradation of the natural resource base.
- Dominance of farming system that highly depends on rain.
- Erratic and unreliable nature of the rainfall.

Degradation of land is caused by biotic and abiotic pressures. An ever increasing population places enormous demand on land resources. These pressures have led to drastic changes in the proportion of land utilized for agricultural activities, urbanization and industrial development. Land degradation has a direct bearing on the productivity of soil, its vulnerability to rainfall variations, scarcity of drinking water, fodder and fuel wood. Given the interlink ages of crop production, livestock economy and environment, land degradation has a major impact on the livelihoods of the people, especially in rural areas.

Some of the most degraded lands in the country are the common property resources (CPRs). CPRs are resources on which people have an equal right of use. These resources include community pastures, community forests, wastelands and common dumping and threshing grounds.

Restoration ecology is the scientific study and practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action, within a short time frame.

Reforestation is the natural or intentional restocking of existing forests and woodlands that have been depleted, usually through deforestation. Reforestation can be used to improve the quality of human life by soaking up pollution and dust from the air, rebuild natural habitats and ecosystems, mitigate global warming since forests facilitate bio sequestration of atmospheric carbon dioxide, and harvest for resources, particularly timber.

The term reforestation is similar to afforestation, the process of restoring and recreating areas of woodlands or forests that may have existed long ago but were deforested or otherwise removed at some point in the past. Sometimes the term re-afforestation is used to distinguish between the original forest cover and the later re-growth of forest to an area. Special tools, e.g. tree planting bar, are used to make planting of trees easier and faster.

The purpose of rehabilitating degraded areas is; production gains (socio-economic circumstances) together with improvements in biodiversity and ecosystem function (e.g. watershed protection, reductions in salinity) that lead to more sustainable forms of production.

Restoration for ecological reasons and biodiversity conservation purposes emerged more recently. The idea of restoring forests for ecological reasons was essentially linked to the insight that protected areas, rarely covering more than five to ten per cent of the land area of a given country or region, would not be sufficient to assure their role in conserving the full range of biodiversity. Forest clearing locally impacts on biodiversity through reduced total areas of suitable habitat, change in landscape patterns, and forest fragmentation. Fragmentation induces physical effects such as edge effects, leading to changes in species composition and structure, and isolation, leading to a loss of connectivity.

The Objectives of the Environmental Restoration and Rehabilitation Program are:

- To restore degraded environmental resources, including rare and endangered ecosystems
- To protect important ecosystems and habitats of rare and endangered flora and fauna
- To prevent or minimize future environmental damage
- To enhance the quality of specific environmental resources
- To improve the capacity of eligible organizations to protect, restore and enhance the environment
- To undertake resource recovery and waste avoidance projects and to prevent and/or reduce pollution

1.3 Selecting and preparing natural area restoration tools, equipment and machinery

The choice of tools for rehabilitating specific degraded areas depends first on the priorities and management objectives of stakeholders followed by the costs and benefits associated with available rehabilitation techniques and the economic, social, and environmental values of the land resources in their current and desired future states. These include: Fertilizers, seeds, site cultivation tools, vehicles and wheelbarrow.

1. **Fertilizers-** is any material of natural or synthetic origin (other than liming materials) that is applied to soils or to plant tissues to supply one or more plant nutrients essential to the growth of plants.



Figure.1.1 Organic Fertilizers

2. **Seeds**-A seed is an embryonic plant enclosed in a protective outer covering. The formation of the seed is part of the process of reproduction in seed plants, the spermatophytes, including the gymnosperm and angiosperm plants.



Figure1.2: Different tree seeds

3. **Site cultivation tools** used for earth work

Growing on a small scale require maximum efficiency to allow for economic viability. For this reason, small scale agricultural operation have the potential to be incredibly productive.to reach this level of efficiency, it is important to be equipped with appropriate tools and technologies. These purpose designed tools allow for maximum outputs, thereby providing the greatest economic gain. When growing in a high tunnel, specifically, it is important to use tools that minimize soil compaction and maximize usable space while still performing necessary function.

Table .1.1 Action and tools for area restoration

Action	Tools
Tilling/Breaking Soil	<ul style="list-style-type: none"> • Hand Tiller • Broadfork • Hard-Pan Broadfork • Tilter
Weeding (Hand)	<ul style="list-style-type: none"> • Hand Weeders (Cobrahead, Hand Hoe, Wire Weeder, Lucko)
Weeding (Standing)	<ul style="list-style-type: none"> • Standing Hoes (Collinear, Trapezoid, Wheel, Stirrup) • Wire Weeder • Cobrahead • Flame Weeder
Digging	<ul style="list-style-type: none"> • Spades/Shovels • Digging Fork • Ho-Mi EZ Digger • Hand Trowel
Cultivating	<ul style="list-style-type: none"> • Spring Tooth Cultivator • 3-Tooth Cultivator • Bed Preparation Rake



Figure 1.3.Site cultivation tools

4. **Vehicles**-A *vehicle* (from Latin: vehiculum) is a machine that transports people or load. *Vehicles* include wagons, bicycles, motor *vehicles* (motorcycles, cars, trucks)
5. **Wheelbarrow**-A wheelbarrow is a small hand-propelled vehicle, usually with just one wheel, designed to be pushed and guided by a single person using two handles at the rear or by a sail to push the ancient wheelbarrow by wind. The term "wheelbarrow" is made of two words: "wheel" and "barrow."



Figure 1.4: Wheelbarrows

1.4 Carrying out pre-operational checks on tools, equipment and machinery

1.4.1 Personal protective equipment

No plan of action can be put into place before a risk assessment has been performed. The risk assessment provides a baseline to protect assets, these include the *tools, equipment and machinery required to rehabilitate and restore the degraded areas*, against various threat. So before undertaking any of the operations the tools and equipment should be checked for the safety of the tools and the worker.



Safety glasses must be worn at all times in work areas.



Long and loose hair must be contained.



Hearing protection must be worn.



Sturdy footwear must be worn at all times in work areas.



Close fitting/protective clothing must be worn.



Rings and jewelry must not be worn.

1.4.2 Pre-operational safety checks

- Locate and ensure you are familiar with all machine operations and controls.
- Ensure all guards are fitted, secure and functional. Do not operate if guards are missing or faulty.
- Ensure the engine has operating and maintenance instructions permanently located and clearly visible.
- Ensure the area is clean and clear of grease and oil.
- Check workspaces and walkways to ensure no slip/trip hazards are present.
- Check all safety devices are in good condition.
- Ensure the work area is well ventilated. Start the fume extraction unit before using the machine.
- Ensure all flammable materials are correctly stored before operating.

1.4.3 Operational safety checks

- Only one person shall operate the engine at a time.
- Ensure the area is clear of people and equipment before operating.
- During operation and when cooling down, be aware that parts of the plant are hot and/or rotating.
- Ending operations and cleaning up

- Switch off the machine when work completed.
- Ensure the battery (if fitted) and fuel line are turned off.
- Keep the equipment and work area in a safe, clean and tidy state.

2.1.2 1.4.5 Potential hazards

- ❗ Hot components.
- ❗ Hair/clothing getting caught in moving machine parts.
- ❗ Fume.
- ❗ Trapping hazards.
- ❗ Crushing hazards.
- ❗ Fire.
- ❗ Fuel.

2.1.3 Don't

- ✗ Do not use faulty equipment. Immediately report suspect equipment.
- ✗ Never leave the machine running unattended

1.5 Selecting and using suitable safety and personal protective equipment (PPE)

Occupational health and safety (OHS) is a discipline dealing with the prevention of work-related injuries and diseases as well as the protection and promotion of the health of workers. It aims at the improvement of working conditions and environment. Occupational health entails the promotion and maintenance of the highest degree of physical and mental health and social well-being of workers in all occupations.

Protective clothing, equipment and appliances are complementary to, not a substitute for, full instruction, sufficient training and adequate supervision. There are common PPE in restoration work. These are:

1. Safety wears: Closing – the choice of closing is important for the safety of the natural area workers and has obvious consequences for the working capacity. Ideally, the clothing should protect the workers from radiant heat, rain, thorns, insect bites etc. It should allow free movements of the body, permits easy passage of air and perspiration, look attractive and display bright color for safety purpose.



Figure 1.5 safety wear

2. **Boot** – primarily they help prevent slipping on rock, logs and unstable slopes, protect against sharp objects and falling weight.



Figure 1.6 Boots

3. **Helmets** – are especially important for tree felling and tractor operation. Chain saw operator needs with eye and ear protection.



Figure 1.6 Helmets

4. **Gloves** – also advisable to protect the workers hand against thorns and harmful plants.



Figure 3.6 Gloves

5. **First aid kit** at each work site a first aid box should be available containing adhesive plaster, bandages sterile compressors, triangular bandages, safety pins, and a pair of scissors, forceps, a disinfectant and a short first aid guide written in local language.



Figure 1.7 First aid kits

6. **Face mask** - a protective mask covering the nose and mouth or nose and eyes. A face mask is a device that you wear over your face, for example to prevent yourself from breathing bad air or from spreading germs, or to protect your face when you are in a dangerous situation.



Figure 1.7 Face mask

7. Sun hat – is a broad-brimmed hat that protects the head and neck from the sun. A sun hat (also known as the harvest hat or field hat) is a head covering specifically designed to shade the face and shoulders from the sun. The style of a sun hat can range from small to large brims. However, as a general guideline, the brim is four to seven inches in length.



Figure 1.8 Sun hats

8. Sun screen lotions are used to protect the skin from the harmful effects of the sun. There are various types of sunscreens available in many forms (e.g., cream, lotion, gel). When applying sunscreen to the face, be careful to avoid contact with the body. It is best for infants to stay out of the sun and wear protective clothing (e.g., hats)



Figure 1.9 Sun screen lotions



Self-check 1	Written test
--------------	--------------

Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test I: multiple choice

- Which one of the following is not a Personal Protective Equipment (PPE) in restoration work?(1 points)
A) Clothing B) Helmet C) Chain saw D) Earmuffs
- _____ is a device that you wear over your face. (1points)
A) Sun screen lotions B) Sun hat C) First aid kit D) Face musk

Test II: Short Answer Questions

- What is the importance of consulting with community in rehabilitation works?(2pts)
- what is purpose of rehabilitating degraded areas.(2pts)
- List some of the Objectives of the Environmental Restoration and Rehabilitation Program.(2pts)
- what is purpose of wheelbarrow?(1pts)
- List some materials and tools used for restoration and Rehabilitation Program.(1pts)

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

You can ask your teacher for the copy of the correct answers

LG #11

LO #2- Demarcate area to be rehabilitated

2 Instruction sheet

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

- Observing and following Organizational occupational health and safety procedures, practices, policies, and precautions
- Assessing Soil and existing vegetation
- Conducting and Developing area demarcation activity and the site

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 and follow Organizational occupational health and safety procedures, practices, policies, and precautions
- Assess Soil and existing vegetation
- Conduct and Develop area demarcation activity and the site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

2.1.4 Information Sheet 2

2.2 Observing and following Organizational occupational health and safety procedures, practices, policies, and precautions

2.2.1 Organizational occupational health

Occupational safety and health (OSH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment. This domain is necessarily vast, encompassing a large number of disciplines and numerous workplace and environmental hazards. A wide range of structures, skills, knowledge and analytical capacities are needed to coordinate and implement all of the “building blocks” that make up national OSH systems so that protection is extended to both workers and the environment.

2.2.2 Core OHS principles

Occupational safety and health is an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine including physiology and toxicology ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities. Despite this variety of concerns and interests, certain basic principles can be identified, including the following:

- **All workers have rights.** Workers, as well as employers and governments, must ensure that these rights are protected and must strive to establish and maintain decent working conditions and a decent working environment.

More specifically: work should take place in a safe and healthy working environment; — conditions of work should be consistent with workers’ well-being and human dignity, work should offer real possibilities for personal achievement, self-fulfillment and service to society

- **Occupational safety and health policies must be established.** Such policies must be implemented at both the national (governmental) and enterprise levels. They must be effectively communicated to all parties concerned.

- **A national system for occupational safety and health must be established.** Such a system must include all the mechanisms and elements necessary to build and maintain a preventive safety and health culture. The national system must be maintained, progressively developed and periodically reviewed.
- **A national programme on occupational safety and health must be formulated.** Once formulated, it must be implemented, monitored, evaluated and periodically reviewed.
- **Social partners (that is, employers and workers) and other stakeholders must be consulted.** This should be done during formulation, implementation and review of all policies, systems and programmes.
- **Occupational safety and health programmes and policies must aim at both prevention and protection.** Efforts must be focused above all on primary prevention at the workplace level. Workplaces and working environments should be planned and designed to be safe and healthy.
- **Continuous improvement of occupational safety and health must be promoted.** This is necessary to ensure that national laws, regulations and technical standards to prevent occupational injuries, diseases and deaths are adapted periodically to social, technical and scientific progress and other changes in the world of work. It is best done by the development and implementation of a national policy, national system and national programme.
- **Information is vital for the development and implementation of effective programmes and policies.** The collection and dissemination of accurate information on hazards and hazardous materials, surveillance of workplaces, monitoring of compliance with policies and good practice, and other related activities are central to the establishment and enforcement of effective policies.
- **Health promotion is a central element of occupational health practice.** Efforts must be made to enhance workers' physical, mental and social well-being.
- **Occupational health services covering all workers should be established.** Ideally, all workers in all categories of economic activity should have access to such services, which aim to protect and promote workers' health and improve working conditions.
- **Compensation, rehabilitation and curative services must be made available to workers who suffer occupational injuries, accidents and work related diseases.** Action must be taken to minimize the consequences of occupational hazards.
- **Education and training are vital components of safe, healthy working environments.** Workers and employers must be made aware of the importance of establishing safe working procedures and

of how to do so. Trainers must be trained in areas of special relevance to particular industries, so that they can address the specific occupational safety and health concerns.

- **Workers, employers and competent authorities have certain responsibilities, duties and obligations.** For example, workers must follow established safety procedures; employers must provide safe workplaces and ensure access to first aid; and the competent authorities must devise, communicate and periodically review and update occupational safety and health policies.
- **Policies must be enforced.** A system of inspection must be in place to secure compliance with occupational safety and health measures and other labour legislation.

2.2.3 Elements of OHS

While organizations will have different needs and scope for specific elements required in their health and safety program, the following basic items should be considered in each case:

- Individual responsibility.
- The establishment and role of the health and safety committee or representative.
- Applicable health and safety legislation requirements and organizational health and safety rules.
- Safe work procedures.
- Worker orientation.
- Training and education.
- Workplace inspections.
- Hazard identification, assessment, and control
- Reporting and investigating incidents.
- Emergency planning.
- Medical and first aid.
- Health and safety promotion, including psychological health and prevention of harassment and violence.
- Workplace specific items.
- Review of the health and safety program.

2.2.4 What are examples of the responsibilities of workers?

Examples of responsibilities of workers include:

- Using personal protection and safety equipment as required by the employer.
- Following safe work procedures.

- Knowing and complying with all regulations.
- Reporting any injury or illness immediately to the supervisor or manager.
- Reporting unsafe acts and unsafe conditions to the supervisor or manager
- Participating in the health and safety committees or as the representative.

2.2.5 What are examples of the responsibilities of supervisors?

Examples of responsibilities of first-line supervisors include:

- Instructing workers to follow safe work practices.
- Enforcing health and safety regulations.
- Correcting unsafe acts and unsafe conditions.
- Ensuring that only authorized or adequately trained workers perform tasks or operate equipment.
- Reporting and investigating all incidents.
- Inspecting the areas they have control over and taking remedial action to minimize or eliminate hazards.
- Ensuring equipment is properly maintained.
- Promoting safety awareness in workers.

2.2.6 How do you establish safe work procedures?

Safe work procedures are the safest way of doing a job, job instruction, monitoring performance, and incident investigation.

Job safety analysis (JSA), also known as "job hazard analysis", is the first step in developing the correct procedure. In this analysis, each task of a specific job is examined to identify hazards and to determine the safest way to do the job. Job safety analysis involves the following steps:

- a. Select the job.
- b. Break down the job into a sequence of steps.
- c. Identify the hazards.
- d. Define preventive measures.

The analysis should be conducted on all critical tasks or jobs as a first priority. Critical jobs include:

- Those where frequent incidents and injuries occur.
- Those where severe incidents and injuries occur.
- Those with a potential for injuries.
- New or modified jobs.
- Infrequently performed jobs, such as maintenance.

Job safety analysis is generally carried out by observing a worker doing the job. Members of the joint health and safety committee should participate in this process. The reason for the exercise must be clearly explained to the worker, emphasizing that the job, not the individual, is being studied. Another approach, useful in the analysis of infrequently-performed or new jobs, is group discussion.

A work procedure may consist of more than one specific task. In such cases, each separate task should be analyzed to complete a job safety analysis for that procedure. The final version of the safe work procedure should be presented in a narrative style format that outlines the correct way to do the job in a step-by-step outline. The steps are described in positive terms, pointing out the reasons why they are to be done in this way. Reference may be made to applicable rules and regulations and to the personal protective equipment required, if any. Workers who carry out the tasks should be consulted in developing the procedure.

Table 2.1 Example Job safety analysis Worksheet

Example Job Safety Analysis (JSA) Worksheet			
Industry: Construction			
Operation: Road repair			
Job: Pavement repair			
Task	Who does it	Hazards	How to prevent injury/accident
Operating jack-hammer	Joe Doe	- noise - vibration	- ear protectors - vibration absorbing gloves

Applicable Legislation:
 OH&S Act and Regulations: _____
 (refer to the act and regulations in your jurisdiction)
 Date: _____
 Developed by: _____

2.3 Assessing Soil and existing vegetation

2.3.1 Soil sampling

If severe erosion has taken place or if fertility has been depleted the soils may no longer be suitable for the original species and a new community, possibly exotic species able to tolerate the changed environment, may take over.

Soil fertility is improved based on the principle of organic farming (tree/crop residues, farm yard manure or promotion of short term fallows). Soils at the site must also remain reasonably intact.

Soil testing is an essential component of soil resource management. Each sample collected must be a true representative of the area being sampled. Utility of the results obtained from the laboratory analysis depends on the sampling precision. Hence, collection of large number of samples is advisable so that sample of desired size can be obtained by sub-sampling. In general, sampling is done at the rate of one sample for every two hectare area. However, at-least one sample should be collected for a maximum area of five hectares. For soil survey work, samples are collected from a soil profile representative to the soil of the surrounding area. Anyone can submit a sample(s) for testing. The Soil Testing Laboratory tests soil samples for pH, phosphate, calcium, magnesium, potassium, iron and copper, etc.

2.3.2 Assessing condition of vegetation

Rapid, on-ground assessments of vegetation condition for biodiversity at the scale of the stand, paddock or remnant or site are part of the daily routine of natural resource management. Rapid assessments based on easily measured biophysical attributes are frequently used as a basis for landholder education, development applications, supporting investment decisions (e.g. incentive funds), prescribing restoration treatments and monitoring change. Thus, assessments of this type are an important medium through which funding for, and regulation of, biodiversity are translated to on-ground actions.

Despite increasing popularity of the term, there is no standard definition of ‘vegetation condition’. It is a concept that reflects a desire to extend vegetation management from a concern about extent, type and configuration to one that also considers quality, health, function or viability. Vegetation condition is a value-laden concept that requires data to be interpreted through a ‘values prism’ along a continuum of ‘good’ to ‘bad’. For example, high perennial weed cover might constitute ‘bad’ condition in one context (e.g. conserving native plant species richness), but ‘good’ condition in another (e.g. lowering water tables for controlling salinity). Thus, when defining vegetation condition one must address questions such as: Good for what? Good for whom? Some definitions of vegetation condition are provided in table 2.2.

Vegetation condition is an interpretation of biophysical data with respect to the values or context in which the assessment is undertaken .For example, a high cover of exotic perennial grass species may be ‘poor’ condition in terms of native plant species composition, but ‘good’ condition in the context of salinity control.

Table 2.2. Different definitions of vegetation condition, quality or health that have been used

Term used	Definition
Habitat quality	The ability of key habitat components to supply the life requisites of selected species of wildlife
Rangeland health	The sustained ability of land to produce forage from rainfall
Range condition	Has its own continuum . . . the position of a particular site along this continuum depends on a judgement of the value of the landscape for a given purpose
Resilience	The predicted degree to which the ecosystem retains a capacity to recover after the removal of the source problem and application of restoration treatments
Vegetation quality	The degree to which the current vegetation differs from mature and apparently long-undisturbed stands of the same vegetation community
Riparian condition	The degree to which human-altered ecosystems diverge from local seminatural ecosystems in their ability to support a community of organisms and perform ecological functions

2.4 Conducting and Developing area demarcation activity and the site

2.4.1 Area demarcation

The external boundary must be evident:

- It defines areas and boundaries with respect to the adjacent landholder; this is especially important where degraded land, agriculture, grazing and grass burning are practiced;
- It takes a legal claim to avoid unsuspecting trespass or theft;

- iii. In the few years after planting, trees are not always obvious and a well-defined boundary will lessen the chance of mistakes and accidents.

Where exactly the planting takes place especially the boundary of it is crucial factor in social and community forestry projects. Involvement of local people in these discussions is excellent people's participation and encourages their commitment.

Boundaries should be defined and marked using beams which may be durable wooden poles, stones or concrete pillars. The poles should be between 1.5 to 2 m tall. Continuous line of live trees or shrubs can also be used as boundary. These trees or shrubs should be fast growing and distinctively different from surrounding forest vegetation. Plantation boundaries are frequently marked by a stout fence, which is erected for protection purposes. Where protection is not needed some permanent marking, such as concrete pillars should be erected at least at corners and changes of direction.

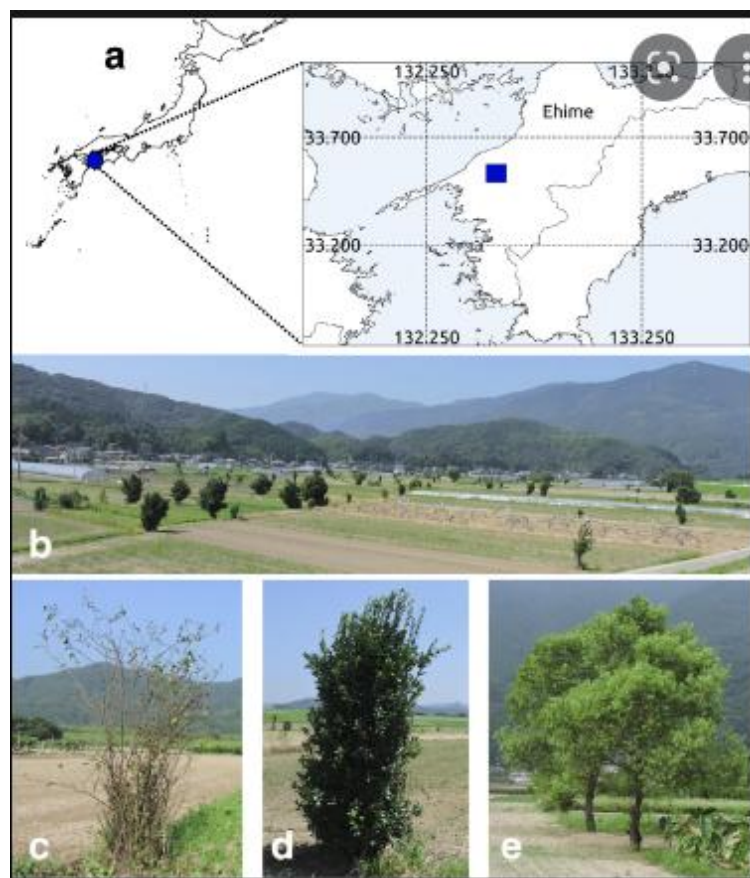


Figure 2.1: Tracing chronological shifts in farmland demarcation trees

All we can do for now is to rehabilitate certain ecological functions, through reconstruction of ecological structures on a limited basis, which were lost by environmental degradations.

Agro ecological condition includes: climate, soil, physiography, and biotic factors to be assessed. The species selection first must be adapted to the site condition. The climate, soil, and biotic factors affect the growth and performance of trees shrubs and other forms of vegetation directly while the physiographic factors affect the climate and the soil thus affect the vegetation. From the point of view of selecting species for rehabilitation systems, several climatic parameters should be considered, such as annual rain fall, humidity, number of rainy days, mean minimum and mean maximum with extreme range of temperature.

Along with ecological criteria such as biodiversity richness and the extent of fragmentation and degradation selecting forest landscape rehabilitation (FLR) target zones according to topographic criteria. They regard the following landscape types as particularly appropriate for FLR: riparian and steep areas, saline or water-logged areas, mining sites, habitats of particular species, buffer zones around protected areas, corridors between protected areas and forest fragments, buffer strips within and around plantations, and over logged or secondary re-growth forests and other degraded areas.

2.4.2 Developing map

The pre planting survey is a detailed study of the rehabilitation area to enable a manager or villager:

- To decide what land should be left unplanted for protection, conservation, landscape or amenity reasons;
- To select species for planting by site type;
- To determine what ground preparation is required;
- To consider possible harvesting systems;
- To plan internal lay outs of roads, bridges, firebreaks and location of water points, depots etc taking in to account.

The pre-planting survey differs from a general site evaluation survey to assess afforestation potential in that it is more detailed study of a particular area to be planted. Of course, the pre-planting survey will include relevant data from the site evaluation work, which normally have preceded it.

Information such as terrain, drainage, soils, vegetation cover, communication, services, and special factors, which may preclude planting, is collected in an orderly way. This will be done by systematic sampling of the land, study of aerial photographs, discussion with former owners, local people and through contact with local or regional government officer. The information is presented both in written and in map form. A convenient map scale is 1:10,000, which can accommodate most details normally required for planning plantation establishment.

Page 28 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

Self-Check – 2

Written test

Name..... ID..... Date.....

Test I: Answer all the questions listed below

1. The external boundary must be evident:
 - A. It defines areas and boundaries with respect to the adjacent landholder
 - B. It takes a legal claim to avoid unsuspecting trespass or theft
 - C. In the few years after planting, trees are not always obvious and a well-defined boundary will lessen the chance of mistakes and accidents.
 - D. All
2. The pre planting survey is a detailed study of the rehabilitation area to enable a manager or villager:
 - A. To decide what land should be left unplanted for protection, conservation
 - B. To select species for planting by site type
 - C. To determine what ground preparation is required
 - D. All
3. A convenient map scale is A. 1:5,000 B. 1:10,000 C. 1:250,000 D. 1:50,000
4. One of following landscape types is appropriate for selecting forest landscape rehabilitation.
 - A. riparian and steep areas
 - B. saline or water-logged areas
 - C. mining sites, habitats of particular species
 - D. D. All

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

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

Operation Sheet -2

2.1 Soil sampling

A. Tools and equipment's

I. Auger (screw or tube or post hole type)

II. Spade

III. Core sample

IV. Sampling bags

V. Plastic tray or bucket

VI. Soil

VII. Water

B. Soil sampling procedures

- Develop a soil sampling plan of your field. Samples should represent the area being tested, so collect samples from areas that are of the same soil type, appearance, or cropping history. Sample problem areas separately, if needed. From this plan, count the number of samples you will collect.
- Soil sample bags and address transporting boxes available if you are using Extension Soil Testing Laboratory.
- Obtain the materials you need to complete your sampling plan.
- In the standing crop, collect samples between rows.
- Sampling at several locations in a zig-zag pattern ensures homogeneity.
- Fields, which is similar in appearance, production and past-management practices, can be grouped into a single sampling unit.
- Collect separate samples from fields that differ in colour, slope, drainage, past
- Management practices like liming, gypsum application, fertilization, cropping system etc.
- Avoid sampling in dead furrows, wet spots, areas near main bund, trees, and manure heaps and irrigation channels.
- For shallow rooted crops, collect samples up to 15 cm depth. For deep rooted crops, collect samples up to 30 cm depth. For tree crops, collect profile samples.
- Always collect the soil sample in presence of the farm owner who knows the farm better
- Divide the field into different homogenous units based on the visual observation and farmer's experience.

- Remove the surface litter at the sampling spot.
- Drive the auger to a plough depth of 15 cm and draw the soil sample.
- Collect at least 10 to 15 samples from each sampling unit and place in a bucket or tray.
- If auger is not available, make a ‘V’ shaped cut to a depth of 15 cm in the sampling spot using spade.
- Remove thick slices of soil from top to bottom of exposed face of the ‘V’ shaped cut and place in a clean container.

2.2 Developing map of demarcated area

A. Tools and equipment's

- I. GPS
- II. Pen and pencil
- III. Notebook
- IV. Eraser
- V. Point filling format sheet
- VI. Computer
- VII. GIS Software
- VIII. plan meter

B. Methods of Developing map

- Division area into triangle
- Offset from straight line
- Double meridian distance
- Coordinate square
- Use plan meter
- plotting traverse
- plotting details
- Drawing topography and specific
- Finishing the map

Other way of developing map

- Collect coordinate points
- Inter collected points into computer excel and save it
- Install and open GIS software on your computer
- Browse coordinate points from your computer
- Develop map



LAP TEST-2

Performance Test

Name..... ID.....

Date.....

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5hour. The project is expected from each student to do it.

Task-1 perform soil sampling

Task-2 Develop map of degraded area

LG #12

LO #3- Implement rehabilitation and restoration activities

Instruction sheet

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 to enrich the degraded area
- 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 outcomes 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 to enrich the degraded area
- Plan best type and species of trees for afforestation
- Enhance community participation to rehabilitation activity
- Follow up and evaluating Rehabilitation activity progress

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 3

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.

3.2 Identifying existing species to restore degraded area

3.2.1 Species characteristics

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 phytoremediation (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.

3.2.2 Soil seed bank test

Soil seed banks of orchids are presumed to be present at population sites. 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. 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.

3.2.3 Toxic species for environment

Although the majority of phytoplankton is 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 bio magnification 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, "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.

“Heavy metal is a huge part to environmental pollutions and their toxicity "is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons.

3.3 Selecting potential species to enrich the degraded area

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 vegetative/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.

3.4 Planning best type and species of trees for afforestation

3.4.1 Planning and selecting species

Forests can be created in different ways. An existing 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.

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 earth ball.

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.

3.5 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.

Page 39 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

- 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 implements projects; and 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

- **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.

In some cases, restoration specialists simply need to remove the source of the disturbance and allow sites to recover naturally through ecological succession. This process is called passive restoration because restoration specialists do not need to take much action. For example, halting agricultural tillage or stemming the overuse of riverbanks by livestock may be enough to bring a site back to a pre-disturbed state.

In other cases, the ecosystem has passed a threshold of degradation, and disturbed sites within it are not able to recover on their own or can only recover very slowly. This is particularly common when soil and water resources have been compromised through erosion, earth-moving activities, or some other major disturbance. To restore such highly disturbed sites, the removal or cessation of the disturbance is only the first step. Restoration's must then engage in active restoration, which starts or accelerates the recovery process or attempts to change the site's ecological succession.

One component of active restoration is soil rehabilitation and land stabilization. This component includes the restoration of the soil's or water's original chemical, biological, and physical characteristics. Examples include applying amendments (such as lime) to improve soil **pH**, stemming the flow of fertilizers to artificially enriched soil or water, inoculating soils with **beneficial** microorganisms, and tilling to improve aeration and **root** penetration. Erosion control and land stabilization tools include physical structures along stream banks, blankets of mulch placed on hillsides, and plantings to stabilize slopes.

Another component of active restoration is restoring the plant **community**. After the site is prepared, restorationists generally select **seeds**, seedlings, or cuttings for vegetation. Ecological principles related to the assembly of the biological **community** help explain the long-term consequences of how and when different species are added to a site.

When selecting seeds and propagules, restorationists generally try to find the species and **cultivars** that will be most suitable for local conditions as well as for the site's intended uses (such as habitat for native wildlife, land stabilization, or livestock forage). Local plants and animals are likely to be well adapted to the target ecosystem. Alternatively, restorationists may use plant materials from seed companies or nurseries that are typically tailored for certain environmental conditions.

At the same time, many restoration attempt to maximize the genetic **diversity** of the site by collecting seeds or propagules from a large number of source individuals. Increased genetic diversity gives restored plant populations a greater ability to survive disturbance events and other ecosystem changes. Such genetic concerns can also be important for animals, which are sometimes transported or reintroduced to an area.

To create a sustainable restored ecosystem, restoration specialists often need to couple the restoration of plants and animals with that of landscape processes and natural disturbances. Some restored sites are relatively small and isolated, which can lead to problems associated with fragmented habitats. Populations in smaller and more-isolated habitat patches experience a greater risk of **inbreeding**, local **extinction** of species, and negative edge effects (that is, the effects of one habitat on an **adjacent** habitat). For example, small, narrow, sinuous patches of forest have greater amounts of edge than larger square or circular patches. As a result, more of their interiors border other ecosystems, which may increase the forest's exposure to different **pests**, predators, and **weather** and **climatic** conditions than would normally occur in forests with shorter borders and thus more-insulated interiors.

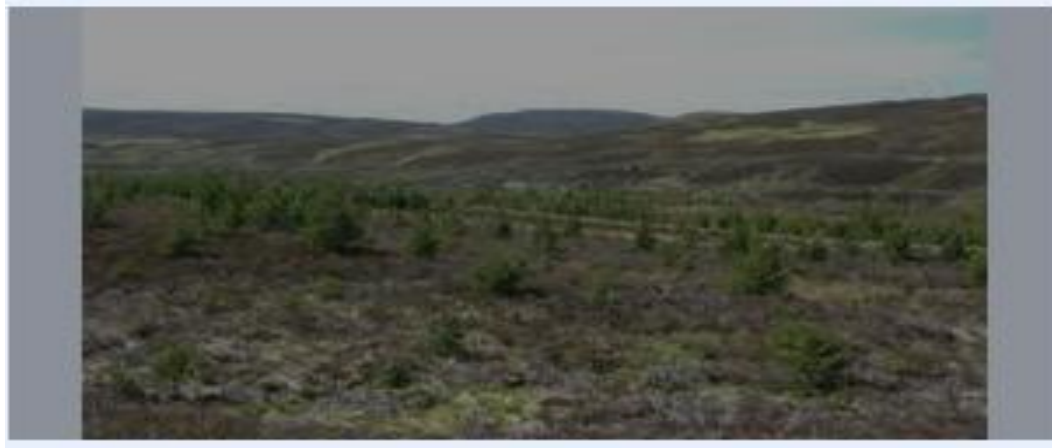


Figure 3.1 Natural Regeneration

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 propagates 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.

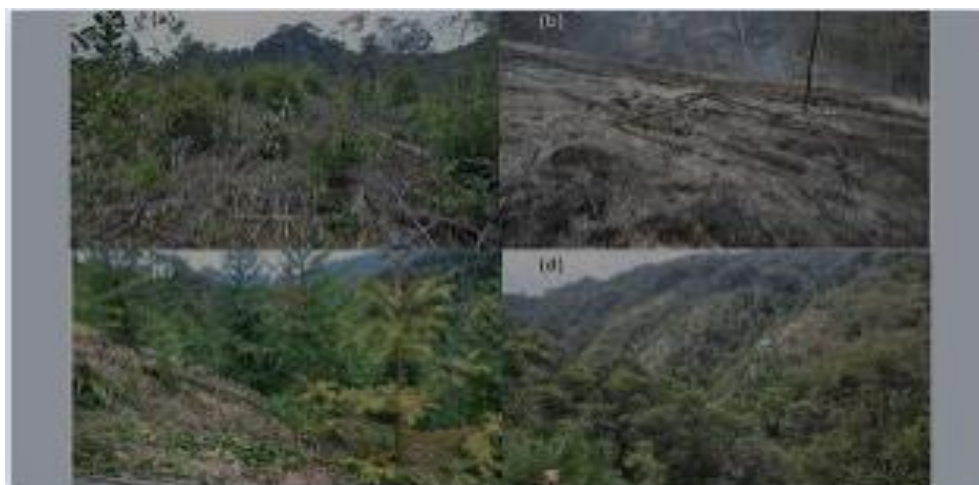


Figure 3.2 Assisted Natural Regeneration

- **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.



Figure 3.3 Area closure

- **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. 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 story. 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. Other options include fodder incorporation along strips or multi-story systems.

- **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

Mechanical soil and water conservation measures

1. Bunds
2. Terraces
3. Trenches
4. Ditches

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:

Agronomicpractices	soilmanagement	Mechanical
<ul style="list-style-type: none"> • Organic content improvement • multiple cropping • cover cropping • strip cropping • crop rotation • grass strip • contour farming • mulching 	<ul style="list-style-type: none"> • conservation tillage • land classification for efficient utilization of farm resources 	<ul style="list-style-type: none"> • Terraces • waterways cutoff drain

3.6 Following up and evaluating Rehabilitation activity progress

3.6.1 The community-based rehabilitation (CBR)

The community-based rehabilitation (CBR) matrix consists of five components (Health, Education, Livelihood, Social and Empowerment) and their associated elements. It provides a basic framework which can be used to develop new CBR programmes. Even though a common matrix now exists, each CBR programme will continue to demonstrate unique differences because it is influenced by a wide range of factors, e.g. physical, socioeconomic, cultural and political factors.

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. CBR programmes carry out many common activities, such as facilitating the formation of self-help groups, facilitating access to health, education, livelihood and social opportunities, and community mobilization, they also display unique differences because of the different contexts in which they operate.

Through evaluation, they have learned a number of valuable management lessons over the years. These include the importance of:

- Involving key stakeholders at all levels of the management cycle;
- Performing a proper situation analysis before starting a CBR programme;
- Making a solid investment in initial planning, ensuring that clear indicators are developed;
- Developing partnerships with key stakeholders, and ensuring there are clearly defined roles and responsibilities partnerships with local government are essential;
- Initiating activities that benefit the whole community, not just a few disabled people;
- Recruiting CBR personnel from local communities and giving preference to people with disabilities, particularly women;
- Ensuring that capacity-building is an ongoing process and inclusive of everyone, e.g. People with disabilities, their families, community members, service providers and local leaders or decision-makers, sharing successes and failures with others.

3.6.2 Sustaining CBR programmes

While good intentions help to start CBR programmes, they are never enough to run and sustain them. Overall, experience shows that government-led programmes or government-supported programmes provide more resources and have a larger reach and better sustainability, compared with civil society programmes. However, programmes led by civil society usually make CBR more appropriate, make it work in difficult situations, and ensure better community participation and sense of ownership. CBR has been most successful where there is government support and where it is sensitive to local factors, such as culture, finances, human resources and support from stakeholders, including local authorities and disabled people's organizations.

Some essential ingredients for sustainability which CBR programmes should consider are listed below.

- **Effective leadership** – it would be very difficult to sustain CBR programmes without effective leadership and management. CBR programme managers are responsible for motivating, inspiring, directing and supporting stakeholders to achieve programme goals and outcomes. Thus it is important to select strong leaders who are committed, excellent communicators, and respected by stakeholder groups and the wider community.
- **Partnerships** – if they work separately, CBR programmes are at risk of competing with others in the community, duplicating services and wasting valuable resources. Partnerships can help to make best use of existing resources and sustain CBR programmes by providing mainstreaming opportunities, a greater range of knowledge and skills, financial resources and an additional voice to influence government legislation and policy relating to the rights of persons with disabilities. In many situations, formal arrangements, such as service agreements, memorandums of understanding and contracts can help secure and sustain partners' involvement.
- **Community ownership** – successful CBR programmes have a strong sense of community ownership. This can be achieved by ensuring the participation of key stakeholders at all stages of the management cycle.
- **Using local resources** – reducing the dependency on human, financial and material resources from external sources will help ensure greater sustainability. Communities should be encouraged to use their own resources to address the problems they face. The use of local resources should be given priority over national resources, and national resources should be given priority over resources from other countries.

- **Considering cultural factors** – cultures vary, and what may be culturally appropriate for one group of people may not be the same for another group. To ensure CBR programmes are sustainable in different contexts, it is important to consider how they will affect local customs and traditions, what resistance to the programme may be expected and how this resistance would be managed. It is important to find a balance between changing inaccurate beliefs and behaviors related to people with disabilities and adapting programmes and activities to the local context.
- **Building capacity** – building the capacity of stakeholders to plan, implement, monitor and evaluate CBR programmes will contribute to sustainability. CBR programmes should have a strong awareness-raising and training component to help build capacity among stakeholders. For example, building capacity among people with disabilities will ensure that they have the relevant skills to advocate for their inclusion in mainstream initiatives.
- **Financial support** – it is important that all CBR programmes develop stable funding sources. A range of different funding options may be available, including government funding (e.g. direct financing or grants), donor funding (e.g. submitting project proposals to national or international donors for funding, in-kind donations or sponsorship), and self-generated income (e.g. selling products, fees and charges for services, or microfinance).
- **Political support** – a national CBR policy, a national CBR programme, a CBR network and the necessary budgetary support will ensure that the benefits of the Convention on the Rights of Persons with Disabilities and development initiatives reach all people with disabilities and their families. Inclusion of disability issues in government legislation and policies will also ensure lasting benefits for people with disabilities in terms of their access to services and opportunities in the health, education, livelihood and social sectors.

3.6.3 Scaling-up of CBR programmes

Scaling-up of CBR programmes means expanding the impact of a successful programme. This will have a number of benefits, for example, CBR will be extended to more people with disabilities who have unmet needs, it will contribute to a growing awareness of disability issues in society and may also increase support for changes in policies and resource allocation related to disability. Scaling-up requires (i) demonstration of programme effectiveness; (ii) acceptance by people with disabilities and

their family members; (iii) acceptance by the community; (iv) sufficient financial resources; and (v) clear legislation and policies.

There are many different ways a CBR programme could be scaled up. One way is to increase the geographical coverage of the programme that is, expand the programme beyond a single community to several communities or to the regional or even national level. However, in general, it is suggested that CBR programmes start small in areas that are easy to reach and show results before they consider scaling up. As many CBR programmes focus on people with a specific impairment, another way they could scale up is to accommodate people with different types of impairments.

3.6.4 Community based rehabilitation management cycle

When thinking about developing or strengthening a CBR programme, it is helpful to visualize the whole management process as a cycle. This ensures that all the main parts are considered, and shows how they all fit and link with one another. In these guidelines, the management cycle consists of the following four stages.



Figure 3.1: Management cycle.

1. **Situation analysis** – this stage looks at the current situation in the community for people with disabilities and their families, and identifies the problems and issues that need to be addressed.
2. **Planning and design** – the next stage involves deciding what the CBR programme should do to address these problems and issues, and planning how to do it.

3. **Implementation and monitoring** – at this stage, the programme is carried out, with regular monitoring and review to ensure it is on the right track.
4. **Evaluation** – this stage measures the programme against its outcomes to see whether and how the outcomes have been met and assess the overall impact of the programme, e.g. what changes have occurred as a result of the programme.

Self-Check – 3

Written test

Name..... ID..... Date.....

Answer all the questions listed below

Test I: Fill the black spaces

1. _____ is given highest priority at all levels and involving all stakeholders in planning, implementation and benefit-sharing of rehabilitation(1pt)
2. _____ is defined as the introduction of valuable species to degraded forests without the elimination of valuable individuals already present. (1pt)
3. _____ is a very low input conservation measure because the only thing that is practice is to prohibit livestock & human interference. (1Pt)

Test II: give short answers for the following question

1. What is the primary objective of soil sampling?(2pts)
2. What is the Characteristics of identified existing species to restore degraded area (2pts)
3. What is the effect of toxic species for environment? (2pts)
4. What is afforestation?(1pts)

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

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

Operation Sheet 3

3.1 Conducting Area closure and enrichment planting

A. Tools and equipment's

- I.PPE
- II.Tree seedlings
- III.Wire
- IV.Spade
- V.Pickaxes
- VI.Hoe
- VII.Pole
- VIII.Nile
- IX.Hammer

B. Methods of Conducting Area closure and enrichment planting

1. Conducting Area closure

- Collect all necessary information of agro ecology
- Divide the field into different homogenous units based on the visual observation and farmer's experience.
- Record identified species.
- Identify degraded/affected area by surveying
- Fencing (live fence, wire)
- Apply passive and active activities of restoration.
- Monitor area closure

2. Enrichment planting

- 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



LAP TEST-3

Performance Test

Name..... ID.....Date.....

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5hour. The project is expected from each student to do it.

Task-1 perform Area closure

Task-2 performEnrichment planting

LG #13

LO #4-Document and report information

Instruction sheet

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

- Reporting problems or difficulties or hazards
- Recording and documenting all rehabilitation and restoration activities
- Documenting and reporting work outcomes

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:

- Report problems or difficulties or hazards
- Record and documenting all rehabilitation and restoration activities
- Document and report work outcomes

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 4

4.1 Reporting problems or difficulties or hazards

The most common workplace hazards include safety hazards like slip-and-falls or electrical hazards. But there are also ergonomic workplace hazards, environmental, chemical and others.

Biological Hazards

- Blood and other body fluids.
- Fungi/mold.
- Bacteria and viruses.
- Plants.
- Insect bites.
- Animal and bird droppings.

Hazard identification is part of the process used to evaluate if any particular situation, item, thing, etc. may have the potential to cause harm. The term often used to describe the full process is risk assessment: Identify hazards and risk factors that have the potential to cause harm (hazard identification).

One of the most common challenges in communicating risk data is not having a standardized and effective process in place. When a claim or incident occurs, employees are not sure about the best way to submit relevant information to the risk team. In this scenario, they will likely turn to the method that is most convenient in the moment, regardless of how this influences risk managers. Even worse, an employee may be unable to submit information or willingly decide not to if the process is too difficult.

On a high-level, risk data can create communication challenges across the organization. Employees know that it is important to analyze data about claims, losses, and trends, but who should be responsible for owning and acting on this data. The lack of a standardized process creates two key issues that will be discussed in the following sections: time-consuming processes and redundant tasks that frustrate employees.

Technology-based communication processes are easy to standardize. When something goes wrong in the organization, an employee will know exactly what is required to report the incident to the risk team. The process may go something like this:

- The employee accesses a data submission web portal from their computer, tablet, or cellphone.
- The employee fills in all relevant details including the names and contact information of all parties, a description of what happened, and any relevant images or documentation. Mandatory fields and drop-down menus will prompt the employee and ensure nothing is missed.
- The employee submits the form and data is instantly sent to the risk team and uploaded into the risk system for further action.
- From the system, the risk team can quickly share data and reports with executives or other team members as necessary.

4.2 Recording and documenting all rehabilitation and restoration activities

Documenting is an official paper or book that gives information about something, or that can be used as evidence or proof of something. In this case, documenting the information means, recording in an official paper about accurate information

Therefore, documenting of information is process of writing and retaining record of every step of ex-situ conservation and its recommended action. Finally reporting to responsible bodies

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

Restoration projects differ in their objectives and their methods of achieving those goals. Many restoration projects aim to establish ecosystems composed of a native species; other projects attempt to restore, improve, or create particular ecosystem functions, such as pollination or erosion control.

Restoration ecology is the scientific study supporting the practice of ecological restoration, which is the practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action. It is important to document all steps taken during any recovery, no matter the size or extent of damage. This documentation will help later to reevaluate your vital records plan or to verify which records were beyond recovery and were immediately destroyed. For example, Water damage to records starts within the first 8 hours after a disaster.

After 24 hours, records will start to stick to each other, and within 48 hours paper will begin to chemically breakdown and to show the initial stages of fungal growth. With photographic and magnetic/electronic media, the breakdown will begin sooner and can be more devastating. The concept of record is variously defined. The ISO 15489-1:2016 defines records as "information created, received, and maintained as evidence and as an asset by an organization or person, in pursuit of legal obligations or in the transaction of business". While there are many purposes of and benefits to records management, as both these definitions highlight, a key feature of records is their ability to serve as evidence of an event. Proper records management can help preserve this feature of records.

The format and media of records is generally irrelevant for the purposes of records management from the perspective that records must be identified and managed, regardless of their form.

Types of documents

As the world's leader in property restoration and disaster recovery, our specialists are also trained and experienced in document recovery and document restoration. Thanks to advances in technology and equipment, we can restore almost any type of document including (but not limited to):

- Books, Files, Magazines, Manuscripts
- Archives, Special Collections, Library Materials
- Audio Tapes, Video Tapes

- Blueprints, Drawings, Maps, Plans
- Compact Discs, Diskettes, Laser Discs, Magnetic Media
- Data Files, Vital Records
- Film, Negatives, Photographs, Slides
- Microfiche, Microfilm
- Parchment
- Vellum
- Whiteprints
- X-rays

The main data to be collected deal with:

- Demography:** population in the zone in question, agricultural population, number of working people, trends.
- Farming:** type of farming (family, industrial, etc.), areas farmed, production (type, yield, costs), agricultural income.
- Soil utilization:** agriculture, animal breeding, forest, industrial or urban zones;
- Animal breeding**
- Agricultural policy,** development plans, current legislative measures.

Data analysis

An over-all review should be made of agricultural activity and soil utilization in order to specify all sectors those might be affected by soil degradation.

Items which may be damaged or disrupted may be classified under three headings:

- Permanent assets such as land, agricultural infrastructure (buildings, irrigation networks), the infrastructure of economic activity (roads, etc.);
- Seasonal assets such as crops which may be damaged to different degrees depending on the intensity and period of occurrence of the phenomenon (flooding, crop destruction, etc.);
- Economic activity which may be perturbed, due for example to the destruction of communication routes, water run-off or by wind-borne materials which may make cultivated land sterile or seriously compromise a region's industry.

Probable economic growth rates should be estimated in order to determine the growth trend in the value of these assets over coming years

It means that the data have to be understandable for another reader.

Page 60 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

Recording data with its unit help us:

- To have definite and accurate reading
- To make data handling simple
- To document data for a long time
- To make it understandable

Different types of soil erosion by water can be identified: loss of topsoil, gulley erosion, riverbank erosion, etc. Soil chemical deterioration Refers to the negative change of the chemical properties of soil. Fertility decline in agriculture productive *areas* is the most common type of chemical degradation. Report includes data on the total area affected by soil degradation. Data is collected using questionnaires.

Outline of a Report format

- Title page
- Acknowledgements
- Contents
- Abstract or summary
- Introduction
- Methodology
- Results or findings
- Discussion
- Conclusion and recommendations
- References
- Appendices

Introduction, which:

- Gives the background
- Explains the purpose, scope and methods used
- Outlines the terms of reference

Methodology – methods or procedure used

Result and discussion – out puts of findings

Conclusion covers the writer's judgment based on information in the body of the report.

Recommendations:

- gives solutions to the problems
- suggests possible courses of action as a result of the conclusions,

E.g. who should take action?

What should be done?

When and how it should be done?

Appendices- contain evidence which supports the report but is not essential because it's either too long or too technical for the audience.

Bibliography -includes all sources of information used in the report and often those used for background reading as well.

Glossary- is an alphabetical list of special words, phrases and terms used in the report, accompanied by a short explanation of each.



Self-check 4

Written test

Name..... ID..... Date.....

Directions: Answer all the questions listed below.

1. What is the Biological Hazards? (3 pts).
2. What type of document you use in restoration degraded area (3 pts).
3. Discuss outline of reporting (4 pts).

Reference

Books

- Bennett, A. F. 1999. *Corridors, Connectivity and Wildlife Conservation*. Gland (Switzerland): IUCN.
- Berger, J.J. 1993. "Ecological restoration and non-indigenous plant species: A review." *Restoration Ecology* 1: 74-82.
- Binkley, D. 1992. Mixtures of nitrogen fixing and non-nitrogen fixing tree species. In M.G.R. Cannell, D.C. Malcolm and P.A. Robertson (eds.). *The Ecology of Mixed Species Stands of Trees*. pp 99-123. Blackwell Scientific.
- Bowles, M.L. and C.J. Whelan (eds.). 1994. *Restoration of Endangered Species: Conceptual issues, planning and implementation*. Cambridge (UK): Cambridge University Press.
- Bradshaw, A. and M.J. Chadwick. 1980. *The Restoration of Land: The ecology and reclamation of derelict and degraded land*. Berkeley: University of California Press.
- Bradley, P.N., N. Chavangi and A. van Gelder. 1985. "Development research and energy planning in Kenya." *Ambio* 14: 228-236.
- Brown, B.J. and J. Ewel. 1987. "Herbivory on complex and simple tropical successional systems." *Ecology* 68: 108-116.
- Butterfield, R. 1996. "Early species selection for tropical reforestation: A consideration of stability." *Forest Ecology and Management* 81: 161-168.
- Chokkalingam, U., D.M. Bhat and G. von Gemmingen. 2001. "Secondary forests associated with the rehabilitation of degraded lands in tropical Asia: A synthesis." *Journal of Tropical Forest Science* 13: 816-831.
- Chokkalingam, U., J. Smith, W. de Jong and C. Sabogal. 2001. "A conceptual framework for the assessment of tropical secondary forest dynamics and sustainable development potential in Asia." *Journal of Tropical Forest Science* 13: 577-600.

Clarke, W.C. and R.R. Thaman (eds.). 1993. *Agroforestry in the Pacific Islands: Systems for sustainability*. Tokyo: United Nations University Press.

Colfer, C.J.P. with R. Prabhu, M. Gunter, C. McDougall, N.M. Porro and R. Porro. 1999. *Who Counts Most? Assessing human well-being in sustainable forest management*. C&I Tool No.8. Bogor (Indonesia): Centre for International Forestry Research (CIFOR)

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

Web

<https://www.youtube.com/watch?v=XOdPJDSTvjM>
<https://www.clearrisk.com/risk-management-blog/challenges-solutions-of-risk-data-communication> (assess date 05/09/2022)

<https://www.slideshare.net/RochelleNato/lesson-1-use-of-farm-tools-and-equipment> (assess date 02/09/2022)

ACKNOWLEDGEMENT

Ministry of Labor and Skills to extend thanks and appreciation to the many representatives of ATVET instructors experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

Page 6 of 69	Ministry of Labor and Skills Author/Copyright	Natural Resources Conservation and Development Level-II	Version -1
			September, 2022

The experts who developed the learning guide

No	Name	Qualification	Educational background	Region	Phone number	E-mail
1	Korme Tusuru	MSc	Biodiversity and conservation Management	Oromia	+251916145234	bilisumakorme@gmail.com
2	Gelasa Tola	MSc	Biodiversity and conservation Management	Oromia	0920049614 0912061230	tolagelasa@gmail.com
3	Gezahegn Tadesse	MSc	Drainage and Watershed Management	Alage	0968445006	sihine29@gmail.com
4	Geleta Bekele	BSc	Forestry	Afar	0925482964	geletabk12019@gmail.com
5	Degarege Mitkie	BSc	Water Resource & Irrigation Engineering	South West	0921281867	mitkiedegarege@gmail.com
6	Getnet Asmare	MSc	Production Forestry	Amhara	0912846540	getnetasmare40@gmail.com
7	Kifle Tolossa	MSc	Soil Science	Alage	0910895568	kifletolossadechasa@gmail.com
8	Tolessa Sori	MSc	Forest & Natural Management	South West	0917007821	tolosa.sori@gmail.com
9	Yeshitila Wondosen	MSc	Climate change & Development	Benshangul Gumuz	0911071229	yeshiwondo@gmail.com
10	Zelege Dessie	MSc	Agroforestry	Oromia	0911091388	zelekedessie@gmail.com
11	Ziyad Rube	MSc	Water Resource Engineering & Management	Afar	0921484656/ 0962639851	yoomnaaf51@gmail.com