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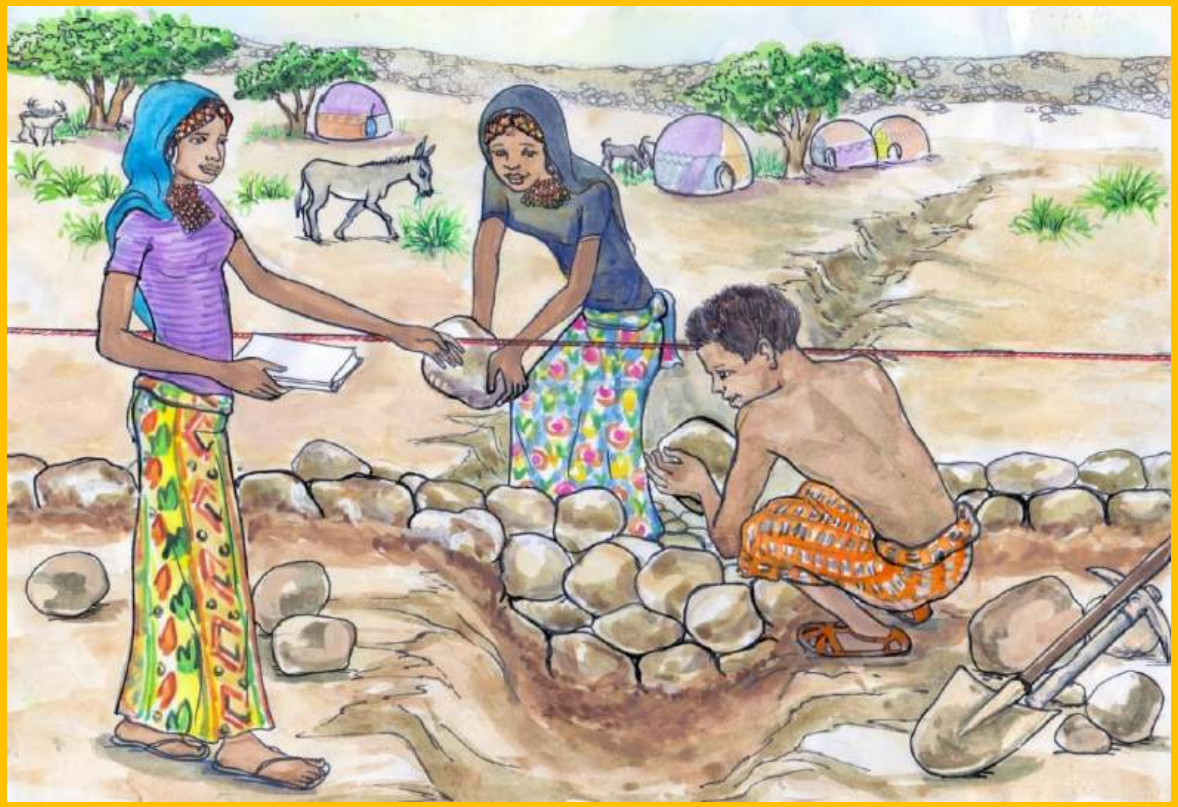
Ministry of Agriculture and Natural Resources

Rehabilitating and Restoring Degraded Areas in Ethiopia's Arid and Semi-Arid Lowlands



Teaching and Learning Guide Dry-Stone Measures

First Edition

Contents

How to use this teaching and learning guide

This Teaching and Learning Guide is part of a series of three Teaching and Learning Guides on:

- Community Awareness Creation, Gender and By-Law development;
- Water Spreading Weirs (WSW);
- Dry-Stone Measures (DSM).

The authors emphasise that comprehensive, gender-based community awareness creation and by-law development and implementation are crucial for optimal planning, construction, use and maintenance of dry-stone measures. It is extremely important that development agents are confident and able in these areas when conducting community development activities.

Teachers and learners should also familiarise themselves with these so-called 'soft skills' by beginning with Teaching and Learning Guide on Creating Community Awareness, Gender Awareness and By-Law Development before continuing with the guides on Water Spreading Weirs and Dry-Stone Measures. These latter guides make regular reference to the Teaching and Learning Guide on Creating Community Awareness, Gender Awareness and By-Law Development but mention only some aspects of community awareness and gender awareness creation which are specific to WSWs and DSMs respectively. Similarly, the correct development and practical application of by-laws are crucial for the protection, utilisation and maintenance of the physical structures.

This guide is arranged around four sections or Learning Outcomes (LOs):

Each Learning Outcome section comprises:

- Introduction with specific learning outcomes;
- An instruction sheet for teachers suggesting a teaching methodology, time needed and guidance through all worksheets;
- An instruction sheet for learners;
- Information sheets on the implementation steps, guiding questions for discussion and self-check test questions;
- Operational sheet, explaining, how to proceed to implement, what is described in the information sheet, indicating the required resources;
- LAP-Test.

The guiding questions for discussion are designed to enhance understanding, learning and reflection on the section's content as well as to serve as a form of self-evaluation.

As a whole, the guide is centred on active participation of students, integrating what they already know in accordance with key adult learning principles and detailing each topic with discussions, outdoor sessions and / or role plays.

A glossary of technical terms at the end of the document explains technical vocabulary and phrases.

Also, since many students of the ATVET colleges are future Development Agents (DA), the Teaching and Learning Guide focuses on their role and tasks.

Content that is especially relevant to Development Agents is marked throughout the document by this illustration of a meeting:

Hints and Tips for Teaching and Training

Adult Learning

Adults learn differently from children and so teaching techniques for adults therefore need to be different from those used with children. The main difference is that adults have considerably more life experience. As a result, adults are keenest to gain information that is most relevant to this lived experience and are inclined to be less interested in that which is not. Key points which help adults learn therefore include the following:

Meaningful information	Starting by helping the learners understand why the topic is important and how it can help them – see also Specific Learning Outcomes.
Experience	Recognising that the learners already have considerable knowledge and life experience, and drawing out this experience as often as possible during learning.
Respect	Adults respond best when they feel that they are respected and that they are part of the learning process. Talk with them, not at them.
Self-exploration	Provide time for adult learners to explore ideas (on their own or in small groups). Let them consider how they might use and apply the learning material.

Teaching through facilitation

Facilitation is an important skill that takes practice and patience to improve. It is much easier for teachers to lecture and to give instructions than to facilitate. However, in order to make learning interesting and to get the best results, a teacher facilitates effectively by assuming the following roles:

- The role of a mentor who assists students with empathy, understanding and encouragement;
- The role of a leader and organiser who initiates, demonstrates, sets goals as well as boundaries;
- The role of a coach who listens, comments, gives feedback and inspires.

Conducting an activity

- Communicate clearly and confidently with your students by speaking and writing clearly.
- Make eye contact and try to be calm and confident with your body language.
- When a student asks a question or makes a point, listen carefully, do not interrupt them, and repeat or summarise what you have heard for everyone before responding - or asking others to respond - to it.
- When explaining ideas, regularly cross-check whether your students have understood what you have said by asking them to summarise, either as individuals or collectively by contributing points.
- As often as possible, elicit information from your students by asking open questions – Why? What? How? – rather than closed Yes-No questions.
- Try to encourage everyone in a group to participate and avoid individuals dominating.

Brainstorming ideas

A brainstorm is a bit like a real storm: it happens quickly. Participants pour out their ideas as soon as they come into their heads, like rain falling.

Brainstorming is a particularly effective teaching method for adults because it draws out students' existing knowledge and experience as a starting point for the learning exercise. It is student-centred and if it is a written brainstorm rather than a verbal one, all of the ideas that have been contributed can be ordered, prioritised and / or reworked from their position on the blackboard or on cards.

Group work

Some of the most productive adult learning takes place during group work. Working in groups places both responsibility for learning and empowerment for self-discovery onto the student, making them active learners rather than passive consumers of information.

Before breaking into groups and starting a given task, it is essential to clarify both the objective and the time frame. Breaking into groups can be done randomly across the class (such as by using a counting system of say 1-2-3-4-5 or by height order), or in a more structured way by grouping friends, neighbours or regular working partners.

Leaders almost always emerge from group work, and so it is often helpful to select a group moderator whose responsibility is to steer the work towards the objective as well as encouraging all members, recording and summarising information.

Groups should never be left alone, rather the facilitator should circulate between groups, observing how each group manages the activity and making suggestions or asking helpful questions if necessary. If a group is off track from the topic, give support and guidance to try and lead the group back toward the objective.

Role Plays

A role play brings a slice of reality into a session. By directly simulating reality, the role play discussion, drama session or game raises questions which require discussion, assessment, negotiation and understanding of real scenarios. In this way role plays are learning experiences for both the actors and the observers.

Evaluation

The Self-Check Test at the end of each Information Sheet, and the LAP-Test after each Operational Sheet of the Teaching and Learning Guide, are designed to help the student reflect on the overall content of a given section. Completing both Self-Check Test and LAP-Test will reinforce what is understood and learned as well as underlining what needs further reflection, reading, discussion or study.

Specific learning objectives

After you have finished working through this guide you should be able to:

- Explain the principles, functions and importance of Dry-Stone Measures, including in terms of community awareness;
- Work closely with communities throughout the process of planning, implementing, utilising and maintaining Dry-Stone Measures (DSM), including in terms of community awareness, gender awareness and by-laws;
- Prepare for the rehabilitation of degraded areas;
- Facilitate the planning and construction of Dry-Stone Measures (DSM);
- Execute the role of a development agent in the overall process;

You should also be fully aware of how to combine physical and biological conservation measures in order to maximise the livelihood benefits of Dry-Stone Measures (DSM).

Learning Outcome 1: Objective and Benefits of Drystone Measures

Development Agents (DA) need to be fully capable of overseeing independently the implementation of Dry-Stone Measures with their working communities. After working through this section, you must come to fully understand the objectives and benefits of Dry-Stone Measures (DSM).

Instruction Sheet for Teachers

- As you go through this Learning Outcome section together with your class, do not start by lecturing them about DSMs from the Information Sheet. Instead, read the Introduction with the specific learning outcome with them and brainstorm ideas about soil and water conservation methods that they already know.
- Then ask them to list the different characteristics of highlands versus lowlands.
- Work through the Information Sheet.
- Ask students to suggest examples of where DSMs might be most suitable. Ask them to explain why.
- Discuss the Guiding Questions.

Teaching methodology

Brainstorming, interactive teaching and learning, group work (listing), discussions.

Session Plan

- 10 minutes looking at the introduction, brainstorming and listing differences;
- 45 minutes for the Information Sheet;
- 20 minutes for the Guiding Questions;
- Total time: 75 minutes.

Instruction sheet for Learners

1. Read the introduction with the specific learning objective for Learning Outcome 1. Familiarise yourself, as a potential future development agent, with your role in the process.
2. Read the Information Sheet on Dry-Stone Measures (DSMs).
3. Write down any questions you have.
4. Ask your teacher for support and seek answers to your questions.
5. Try to answer the Guiding Questions and discuss them with classmates about the advantages, disadvantages and other factors regarding DSMs.
6. Test your knowledge by completing the Self-Check Test.

Information Sheet

Desertification, aggravated by climate change and population growth, is one of the main reasons for poverty across northern and eastern Africa. Erosion caused by the superficial run-off of rainwater dramatically reduces the amount of land available for agriculture, livestock feed and food for people. Competition and conflict over decreasing land and water resources are logical consequences.

In areas where rain only falls a few times year, seasonal streams can swell to large rivers which carry run-off waters with enormous power. These deluges remove huge amounts of top soil and water, causing gully erosion and with very little infiltration into the ground, especially in the valley bottom. Indeed, the drainage effects of gully erosion are more harmful to the environment than soil erosion itself. The visible surface degradation, as well as the lack of infiltration and permeation, reduces biodiversity, biomass and yields, leaving the soil structure vulnerable to further damage.

The next heavy rains then intensify and accelerate the gully development and soil degradation, requiring drastic physical and biological rehabilitation measures in order to reverse the negative cycle.

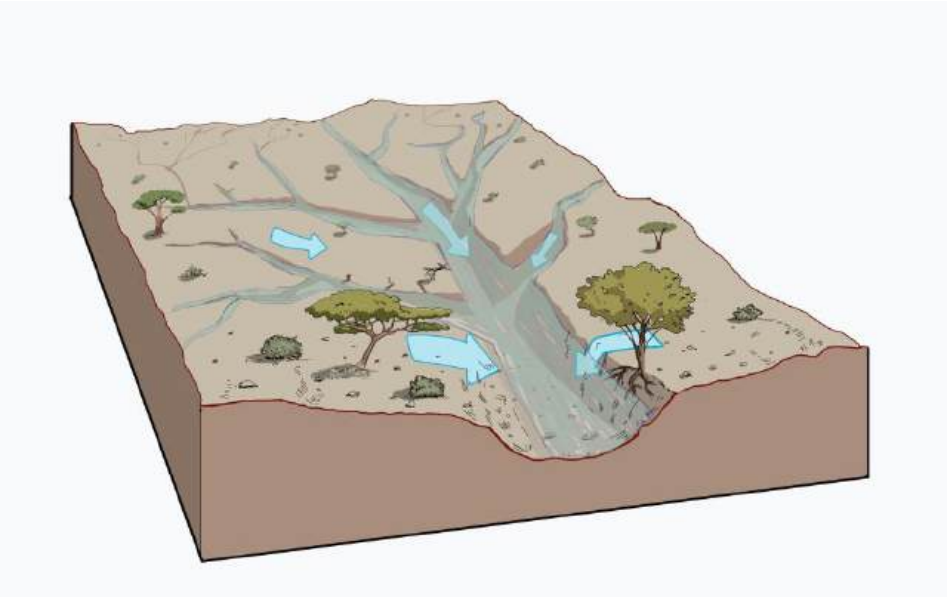


Illustration 1: The appearance of gully erosion marks the change from slow to aggravated degradation

Deforestation and/or overgrazing allows rainfall to take away topsoil and biomass. The remaining soil, not having plant roots, cannot retain rain or flood water any more. It degrades, holding even less water and less biomass and becoming susceptible to subsequent rains. If no physical or natural-resource management practices are applied in time (such as reforestation or area enclosure), gully formation takes place and spreads. Gullies function like a drainage system, taking away even more topsoil, soil water and biomass.

When considering rehabilitation of degraded land it is necessary to look at a watershed as a whole: not only at the dramatic gullies, where large-scale physical rehabilitation measures may be needed, but also at the upstream valley slopes and smaller gullies.

Dry-Stone Measures (DSMs) work by catchment area. They are designed to reduce degradation and prevent gully erosion over large areas of land by reducing the speed of surface run-off, retaining organic matter and enhancing the spreading of water. DSMs function best in combination with biological protection.

Assessing the suitability of dry-stone measures

Dry-Stone Measures are generally best suited:

- on the slopes of valleys (not in a riverbed);
- for early stages of degradation (such as decreasing yields and biomass or biodiversity);
- where a gully is not deeper than 1-2 meters and not too wide.
- in combination with Water Spreading Weirs or behind masonry walls as erosion protection measures, especially in larger valleys.

The term Dry-Stone Measure (DSM) refers to the complete rehabilitation operation of a given area of degraded land, while a dry-stone structure is a single physical construction or instalment.

Illustration 2: Gully erosion

Dry-stone structures

A dry-stone structure is semi-permeable and made of natural stones only. It is built at right angles to the water flow, forming a horizontal line along its upstream facing side. A structure can either span a whole valley (as in Illustration 3) or it can be constructed in small gullies, but with the same aim of spreading water (as in Illustration 4).

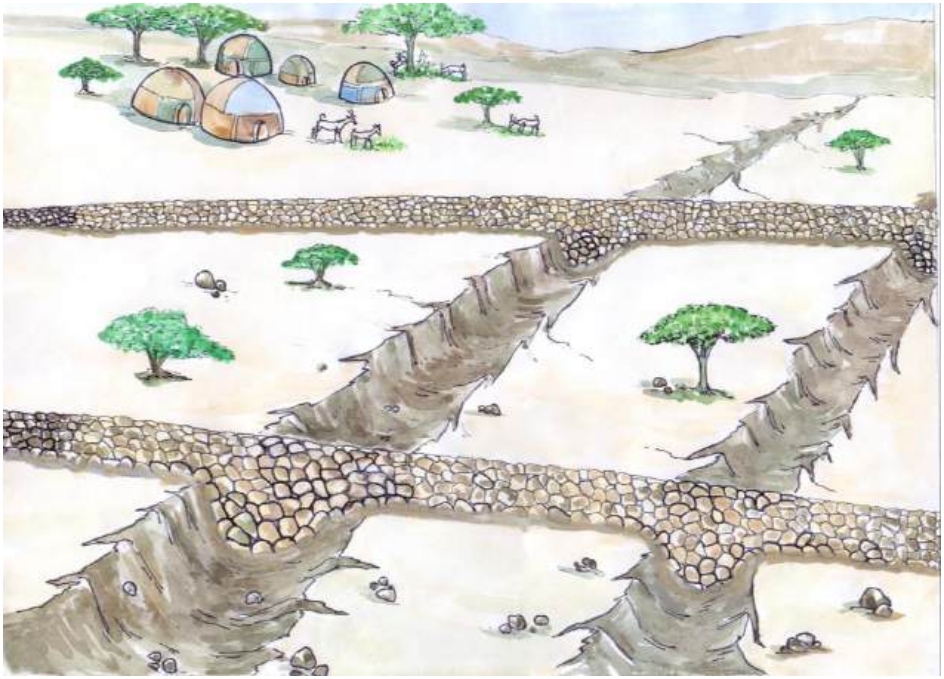


Illustration 3: A sequence of dry-stone dams is constructed to stop the degradation of the watershed

Illustration 4: Drystone structures can also be constructed within small gullies, but with a water spreading effect

The length and extent of dry-stone structures depends on the topography of the site. In most cases several structures are combined in cascades in order to maximise rehabilitation of the watershed by increased water infiltration, sedimentation and establishment of organic matter.

Illustration 5 and Illustration 6 show how water flow is slowed, both percolating through the structure and infiltrating into the ground. Sedimentation builds up behind and in the structure, providing fertile land for agricultural use or fodder production. Simultaneously, erosion to land below the structure is reduced due to the lower velocity of surface run-off. Lower velocity of water also increases infiltration below the dry-stone structure.

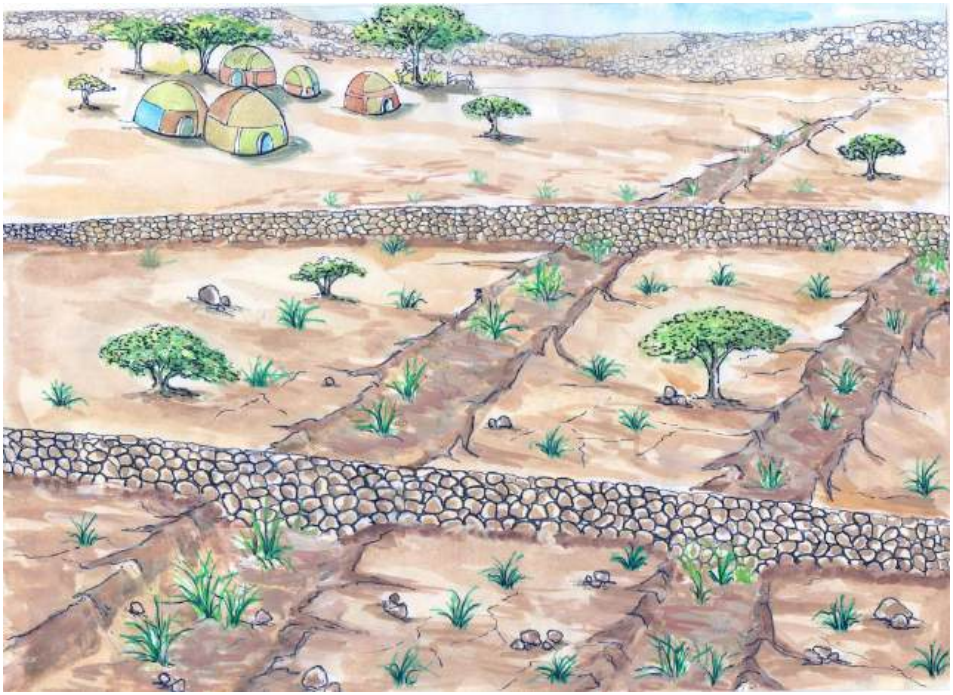


Illustration 5: Sequence of two dry-stone dams. Sediment and water infiltrate, enriching the land above and below the dry-stone dams

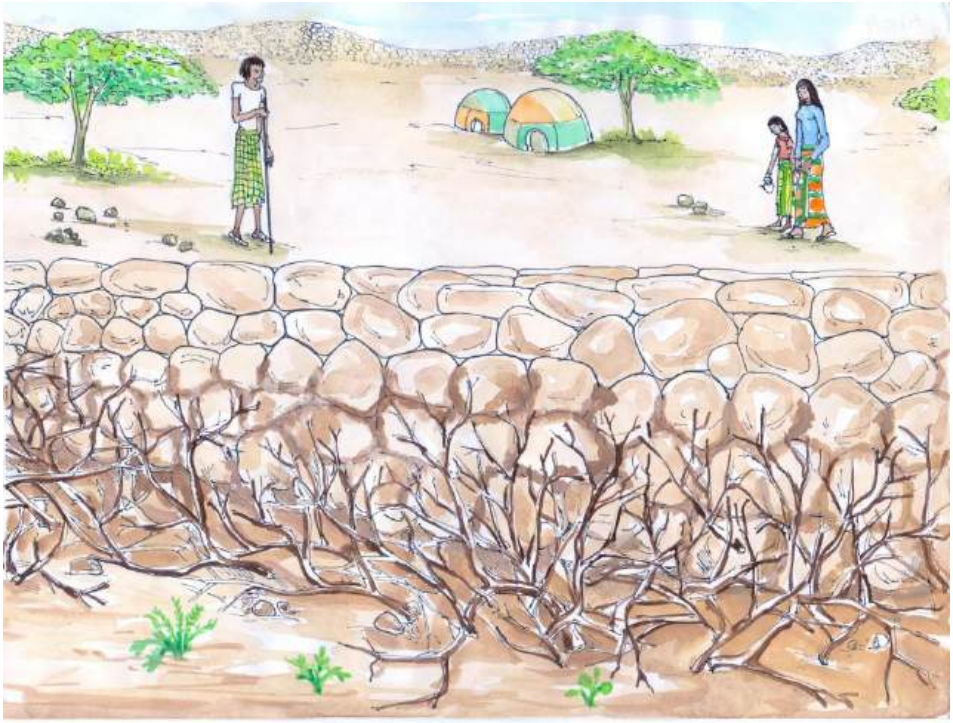


Illustration 6: organic matter will sediment and water infiltrates, enriching the land above and below the drystone structure

Dry-stone structures are relatively easy to construct by local people using exclusively local materials. Wherever stones are locally available they should be easy to maintain by communities themselves. Construction should be overseen by a Development Agent (DA). The DA might request the support of the natural-resource management (NRM) expert of the woreda PADO office, especially in planning the site and working out the layout of structures. Site selection for DSMs is explained under Learning Outcome 2 and steps for construction under Learning Outcome 3.

Depending on the landscape of the watershed, dry-stone structures can feature in combination with water-spreading weirs, such as to rehabilitate smaller gullies on the outer margins of a valley, as shown in Illustration 7 (See also the Teaching and Learning Guide on Water-Spreading Weirs).

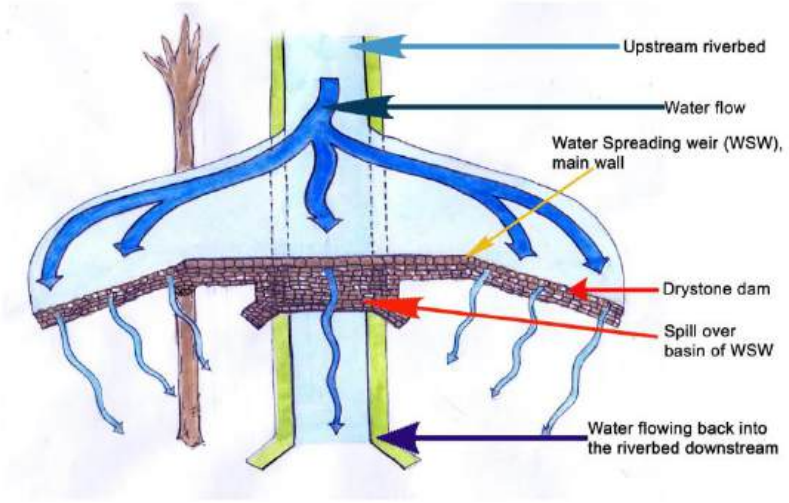


Illustration 7: Water flowing in the main riverbed and laterally (blue arrows). The central part in and left and right of the riverbed are rehabilitated by a Water Spreading Weir with its main wall and spill over basin. Stone dams stabilize the right and left outer parts of the valley.

Benefits of Dry-Stone Measures

Dry-Stone Measures have positive effects on people and on nature. Some effects can be on the short term, others on long term.

Productivity, resilience and livelihood benefits

- Improved food security.
- Increased fodder, grazing and animal production.
- Increased organic matter and thus resilience to heavy rainfall.
- Increased resilience to dry spells.

Ecological benefits

- Increased water availability due to recharged groundwater.
- Increased soil moisture.
- Reduced surface runoff and thus soil loss and erosion.
- Increased biomass and soil organic matter.
- Increased animal and plant diversity.
- Restoration of valley bottoms.

Socio-cultural benefits

- Improved community organisation and strengthened community institutions.
- Improved natural resource management and conservation knowledge.
- Improved planning skills.
- Improvements for women and young people especially.

Who are the Key stakeholders?

A dry-stone structure will only last if it is planned, constructed, used and, perhaps most importantly, maintained by the same people who benefit from it. Who, then are the most important people and entities to be in involved in the construction of a dry-stone structure?

Local people

Community members living in the area and using the land must be involved from the beginning in both planning the measure and determining the use of the rehabilitated land. Community members are the main stakeholders since they use the land and are ultimately responsible for maintenance after construction. See also Learning Outcome 2, Learning Outcome 3 and Learning Outcome 4.

Pastoral Agricultural Development Office and Development Agents

The Pastoral Agricultural Development Office (PADO) is the government authority responsible for agro-pastoral development at woreda (district) level and below. Three DAs – for natural-resource management, crops and animal production respectively – are to live and work in each kebele and represent the PADO. DAs, on behalf of the PADO, lead and oversee the full community awareness, planning, implementation and initial maintenance procedures.

Executing agencies

An executing agency is an international or national NGO, a bilateral or multilateral development partner or the Ethiopian Government. These agencies can be part of the planning and implementation process of the measure, but unlike for Water Spreading Weir implementation, their presence is not essential. This is because DSMs are technically straightforward and can be built by trained community members alone and simply overseen by the DAs.

Guiding questions for discussion

1. What are Dry-Stone Measures?
2. What is the difference between a Dry-Stone Measure and a dry-stone structure?
3. Explain, using a drawing, what a typical dry-stone structure looks like.
4. List the short-, medium- and long-term benefits of DSMs to your classmate.
5. What are the direct beneficiaries of DSMs, and why should these people be involved from the beginning?
6. How can a cascade of dry-stone structures restore a valley bottom?
7. How can a Drystone Measure be combined with a Water Spreading Weir and why?
8. What might be the relation between DSMs and climate change adaptation?

Self-Check Test

Name	
Date	
Time started	
Time finished	

Instructions

Answer all the questions listed below.

Part I: Multiple choices

Which of the following stakeholders is involved in construction of drystone structures ***(2pts)***

1. Local people
2. Executive agencies
3. Development agents
4. All

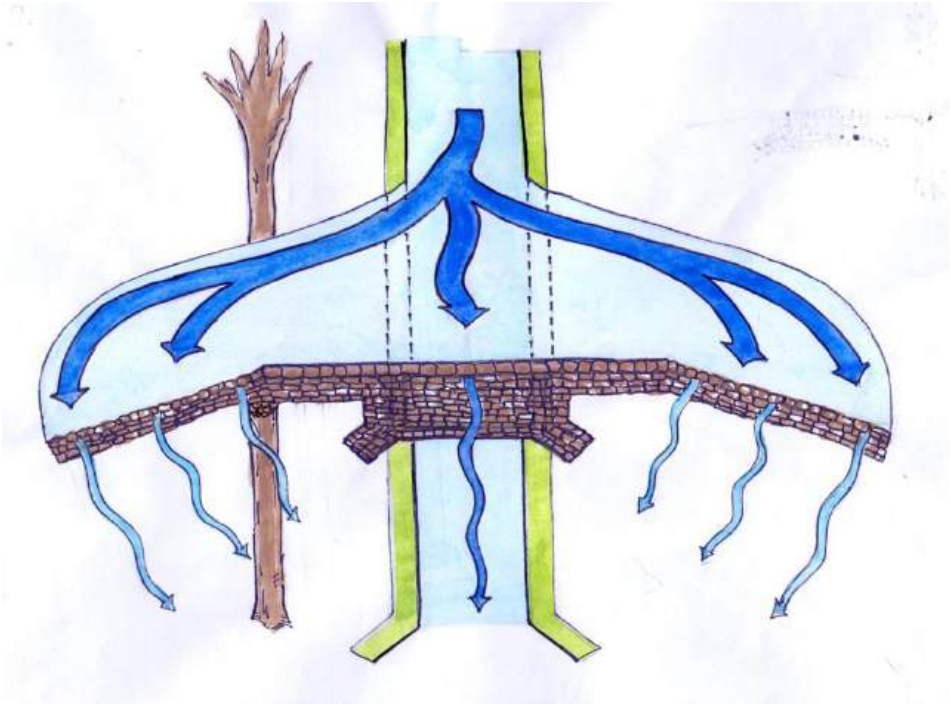
Which of the following structures is semipermeable and made of natural stones only?

1. Watershed
2. Drystone structure
3. Level soil bund
4. Fanyajuu

Part II: Matching

Indicate the appropriate component of the dry-stone structure in the illustration. *(4pts)*

1. River bed upstream
2. Water spreading weir main wall
3. Water flow
4. Dry stone structure



Part III: Short answer

(9 pts)

1. List three ecological benefits of dry stone measures

2. Dry stone measures are suitable for the following conditions

3. List down three positive effects of dry stone measures on people and nature .

Note: Satisfactory rating points 7.5 and above. Unsatisfactory points below 7.5

You can ask your instructor for a copy of the correct answers.

If your answer differs from that of your instructor for a very single point do not proceed to the next learning, rather better work on the same information sheet until you acquire all the necessary information

Score:

Rating:

Learning Outcome 2: Creating Community Awareness and Area Selection

By the end of this Learning Outcome section you should:

• be familiar with the basics of community awareness creation in relation to DSM;

• be able to initiate awareness-creation sessions with communities.

• know the key site-selection criteria for DSMs and be able to make accurate site selections;

• understand your role as a DA in terms of facilitating planning and preparation for DSM implementation;

Instruction Sheet for teachers

- Ask one of your students to read aloud the Introduction of Learning Outcome 2. Ask your students what they understand from the Introduction, and ask what they expect to learn from this section.
- Now ask your students to list down areas that they think might be suitable for a dry-stone structures, based on what they have learned from Learning Outcome 1. What might be the criteria for site selection?
- Next, tell your students to read the Information Sheet carefully.

- Now take your students out of the classroom. Ask them which landscape patterns they are confronted with around the college area. Can they show any examples of erosion? What are the rainfall patterns like in the area,

and what physical evidence is there of run-off and/ or water permeation locally, if any? Would the area around the college be suitable for DSMs? Why? Why not?

- As you go, discuss the Guiding Questions outside. Ask one or two students to take notes summarising all of the points made.
- Now move to the Operational Sheet. Sit outside the classroom under a tree and pretend that as a group you are having a community awareness creation meeting. Work with your students on the procedures. What comes first? What follows? What are the most important things to think about in terms of arrangement of people, numbers of people attending, how you facilitate the discussion, what you tell them and how you draw on the participants' own experience, knowledge and expectations. Use the Operational Sheet as a guide, modelling as a facilitator yourself or nominating a student if you think someone is confident and able to be a model facilitator for the others.

Teaching methodology

Brainstorming, discussion, interactive teaching and learning, outdoor sessions.

Session Plan

- 10 minutes for looking at the Specific Learning Outcome and the brainstorming;
- 30 minutes for the Information Sheet ;
- 30 minutes for the outdoor session, including the Guiding Questions;
- 60 minutes for the Operational Sheet.
- Total: 130 minutes.

Instruction Sheet for Learners

1. Read the Introduction of Learning Outcome 2 again.
2. Read Information Sheet.

3. Write down your questions of clarification, you might have.
4. Ask your teacher for support, and get answer to your questions.
5. Try to answer the Guiding Questions.
6. Complete the self-check-test.
7. Observe the landscape around you, both near your college and close to your home.
8. Read the Operational Sheet..
9. Repeat steps 3, 4 and 5.
10. Complete the LAP-Test.
11. Make a list of open questions to your teacher.
12. Request answers and discuss with your classmates as necessary.

Information Sheet

Deep and thorough creation of community awareness creation about the concept and potential benefits of a proposed intervention – in this case, Dry-Stone Measures – is the starting point of any successful development measure. As has been said earlier, before working through this document it is essential that you first work through the separate Teaching and Learning Guide on Creating Community Awareness, Creating Gender Awareness and Developing By-Laws.

Creating community awareness

Any plan to implement a DSM should:

- begin with careful planning;
- involve all community leaders (administrative, traditional, other influential people) and all community members or those of an administrative sub-unit of a community;
- be gender-sensitive (see separate Teaching and Learning Guide);
- explain very well the benefits and impacts of a DSM to the community;
- obtain the approval and commitment of the respective community or community group to implement DSMs at a given site or collection of sites;
- make the community fully aware of the working responsibilities, procedures and working rules during construction;
- make the community fully aware of the maintenance responsibilities and the community's role in it. It must be made especially clear to the community that DSMs require attention and maintenance regularly, especially after heavy rainfall;
- include by-laws for ownership, maintenance and utilization of the DSM after its completion;
- include a community-action plan which has been developed by the community themselves.

Gender awareness

When talking to a community it is easy to talk only or mainly to men as they are usually the ones who attend meetings in the first place, in greater number and contributing most vocally. On the other hand, making an effort to involve women equally not only respects their human rights, but it is also an crucial part of social development and project sustainability. This is because women bring specific skills and strengths into community development activities which are different from, but equally important to, those of men. It is therefore essential that they are given equal voice, opportunities and encouragement to participate and feel ownership of DSMs by DAs, peers and all other stakeholders. For details on a gender-sensitive approaches and gender awareness, refer back to the Teaching and Learning Guide on Creating Community Awareness, Gender Awareness and By-Law Development.

With regard to dry-stone measures (DSMs), it should be unanimously accepted by all that:

- Women and men have chances and responsibilities to participate in the overall planning, implementation, utilisation and maintenance of the DSM(s);
- Women and men must fully understand the DSM in terms of both its benefits and the responsibilities of managing, sharing and maintaining it. Women should be part of the construction teams, as well as a team leader.
- 50% women's participation should be set as a criterion.

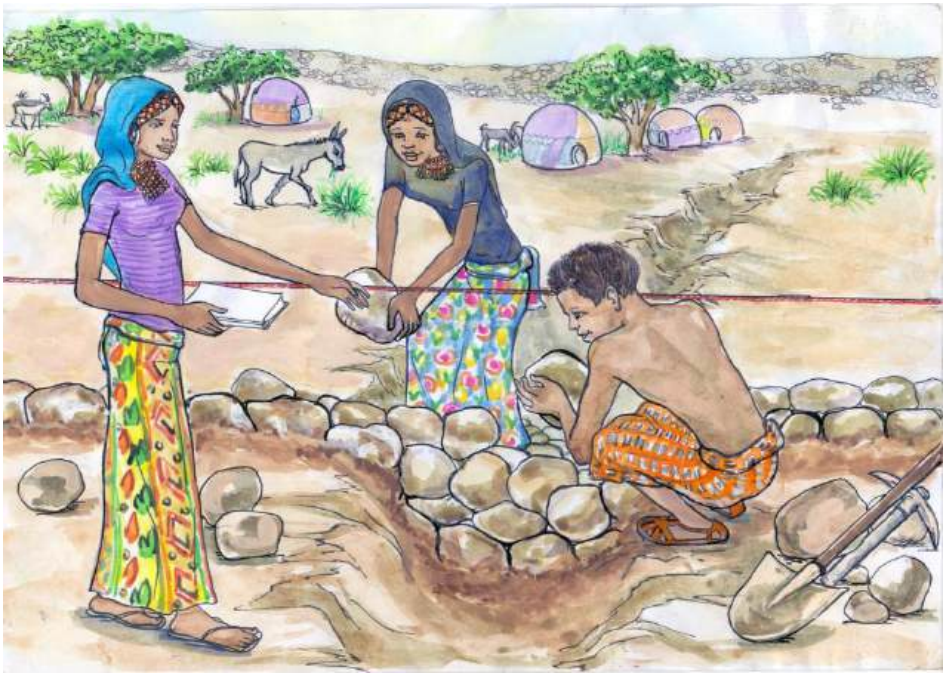


Illustration 8: Women are part of the construction as well and do lead construction teams

Site selection

Construction of dry-stone structures can be undertaken by a trained DA and by community members. The community or their leaders – the kebele leader, the clan leader and elders – should propose sites as generally have the most experience and local knowledge in terms of where erosion takes place and where their land is deteriorating. As a DA, therefore, you need to know the criteria for site selection in order to be able to guide the community. The technical, resource-based and social criteria for selecting sites for dry-stone structures are as follows:

Technical criteria

- Degraded areas with reduced biodiversity and/or soil fertility – often caught in a downward ecological spiral;
- Small gullies are developing or existing;
- Optional: larger riverbed, rehabilitated with a water-spreading weir which has a smaller secondary riverbed or small gully. The dry-stone structure will be complementary and constructed in combination with the larger WSW.

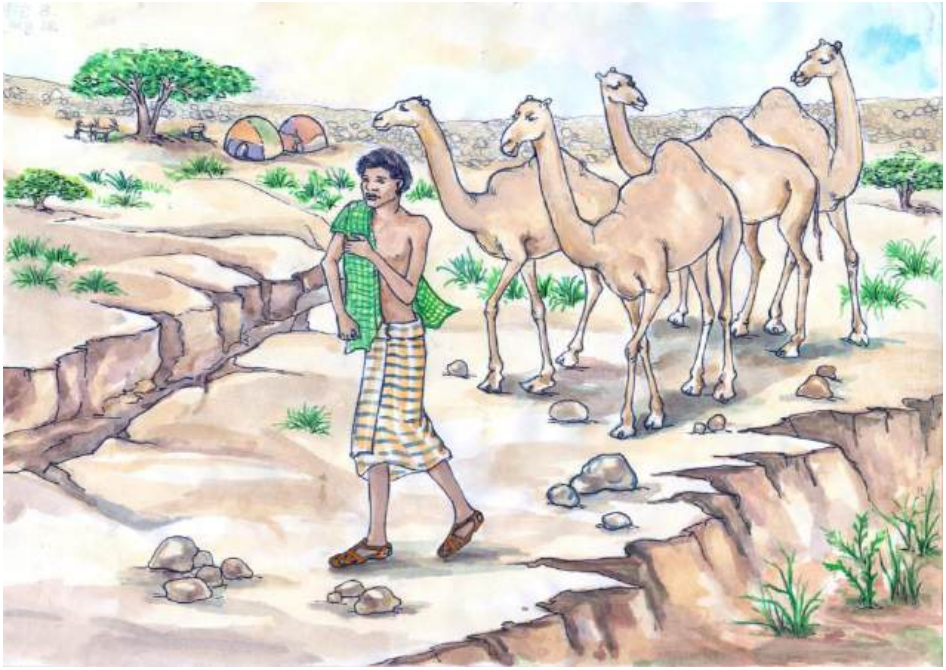


Illustration 9: Example of a selected area

Resource-based criteria

- Larger stones (of at least 25 cm diameter) should be available within 100 m distance of the proposed site – otherwise donkey charts are needed for transport;
- An agricultural potential of the area in terms of crop and fodder production should be guaranteed.

Illustration 10: If big stones are available in less than 100m distance, donkey charts are not needed for transportation

Social criteria

- Community presence, permanent or semi-permanent;
- Community is organized and interested to work in both construction and maintenance;
- The Kebele leader is motivated and enthusiastic;
- DA is ready to lead the community together with community leaders (Kebele leader, clan leader and elders);
- Local PADO ready to support the community and the DA.

Go through all of the above lists of criteria with the community leaders. Do the technical criteria apply? If yes, continue with the resource-based criteria. For example, if there are no stones available nearby, DSMs may be very expensive or unfeasible.

If you can answer the majority of the criteria with yes, scrutinise the social criteria carefully. Are the community leaders strong? Is the community active? Does the community or part of it stay in the village during some time of the dry season, when the dry-stone structures would be built? List all of your answers down.

The duration of construction depends on the landscape (slope, quantity and size of gullies, gully depth, soil type, distance of stone availability) and on the distance of community settlement. It also requires the community's readiness to willingly provide unpaid labour, community leaders' willingness to supervise activities continuously, and the development agent's ability, confidence and commitment to oversee and manage progress.

Example:

At Gariro Kebele, in Chifra Woreda, community members worked for eight weeks with 50 community members. Within this time they collectively rehabilitated an area of 70 hectares with Drystone Measures.

Community members are often divided into groups of ten, each group having a group leader who has been trained by the DA. After a certain period of time (e.g. 14 days), groups should rotate so that the whole community can be involved in the construction and understands the system, as well bringing in fresh hands and giving the outgoing group a rest.

In addition to the selection criteria, the current land use of the proposed site must be well known, universally understood and documented. This is essential in order to anticipate and avoid any risk of conflict.

Distances between two dry-stone structures

As cascades, dry-stone structures may cover large hectares of deteriorated land. The distance between two dry-stone structures depends on the landscape of the watershed, the slope gradient and levels of degradation. In principle, and as a rough orientation, the height of the head of a dry-stone structure should correspond to the height of the foot of the previous dry-stone structure lying upstream, as shown in Illustration 11.

Illustration 11: Distance between dry-stone dams

The role of the Development Agent

The DA is of critical importance in a community because she / he is expected to be the main facilitator of community development processes, helping people to come to decisions (such as by facilitating community meetings and mapping of resources) as well as helping to implement development measures including DSMs and WSWs.

The DA is also required to link local people to institutions such as to the district (woreda) PADO office and to liaise with and link people with other DAs in the community. For example, if the DA for natural-resource management is in charge of supporting dry-stone structure implementation, she/he should also involve the DA for agriculture and livestock, since use of rehabilitated land will involve agriculture and / or livestock keeping.

Last, the Development Agent is required to advise community members while recognising and integrating their local indigenous knowledge.

In terms of planning of DSMs, the DA is required to:

- Continually spread awareness about DSMs;
- Lead the participatory planning process together along with the kebele leader;
- Train the community on how to build dry-stone structures;
- Organise, mobilise and coordinate people at every level of the process.

Guiding questions for discussion

1. Which technical criteria for site selection do you know?
2. What are the resource-based criteria for site selection?
3. Why are dry-stone structures constructed in cascades?
4. Why does community awareness creation take time? Why is it not a one-time meeting?
5. How can gender aspects be considered? Why should gender aspects be considered?
6. What is the role of the Development Agent?

Self-Check-Test

Name	
Date	
Time started	
Time finished	

Instructions

Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Short answers

1. List three technical criteria for area selection for dry-stone measures: (3 points)
2. List three resource-based criteria for area selection for dry-stone measures: (3 points)
3. Why are dry stone structures constructed in cascades? (3 points)
4. Why is community awareness creation a process over a period of time, and not a one-time meeting? (3 points)
5. How and why shall gender aspects be considered? (3 points)
6. What is the role of the Development Agent? (3 points)

Note: Satisfactory rating points 18 and above. Unsatisfactory points below 18.

You can ask your instructor for a copy of the correct answers.

If your answer differs from that of your instructor for a very single point do not proceed to the next learning, rather better work on the same information sheet until you acquire all the necessary information

Score:

Rating:

Operational Sheet

As the DA of your kebele you must lead the community awareness creation process together with the influential people of the village (elders, kebele leader, clan leader) and with PADO representatives such as the NRM expert.

Objective

Men and women in the community are aware of the benefits of DSMs and have selected a deteriorated area for restoration.

Resource requirements

- Venue and materials to facilitate community meetings.
- Selection of people for transect walk and DSM implementation training.

How to proceed

The following chapters depict the sequence of activities to conduct the community awareness creation process. After completing the activities accompany the construction and support the community members actively.

First meeting at Kebele level

In an initial meeting between kebele representatives such as the kebele leader, the clan leader, elders, the DA(s) and the PADO, you should support the kebele and/or clan leader to facilitate the meeting. Together with the PADO representative for natural-resource management (NRM), you should explain the objective and benefit of Dry Stone Measures.

Also organise a transect walk in order to see and verify the area with the community representatives.

First community meeting

Following this first meeting, call for a full community meeting in order to explain DSMs fully to the kebele leader, clan leader, women and youth leaders and the elders. Also discuss the selected area. Invite the PADO to this meeting as well as the DAs for agriculture and animal production. The DA for agriculture and livestock will be involved later in technical assistance about the use of the rehabilitated land.

Together with the kebele leader and the NRM expert, describe the following using clear and simple words and explanation:

- Concrete examples of the direct short- and medium-term benefits of DSMs, as well as the possibilities of utilisation by the community, such as:
    - improved grazing;
    - possibility of area closure for natural regeneration of fodder grasses and shrubs;
    - land below the dam being protected from erosion and used for agriculture;
    - improved yields from agriculture through enriched soil;
    - possibility of a (second) crop such as a vegetable to generate income after the rains;
- Ecological medium- to long-term benefits;
- Show what a dry-stone structure looks like;
- The main steps of the construction process;
- The role and contribution of the community in both construction and maintenance.

Ask community members to describe their own traditional soil- and water-conservation measures. What experience do they have? How do they use the area currently? How will they use the area in the future when it is improved?

If time and number of participants are sufficient (but not numbering more than 50), divide them into groups and ask them to draw a map of their area showing spatial arrangement of all of the available resources, then ask them to describe it and compare their maps. The exercise helps the community to pool their knowledge and understanding of the landscape. It also can raise discussions about challenges, providing key information to you and other DAs and even to the kebele leader.

- Having built awareness, seek the community's approval to contribute to restoring the area with DSMs.
- Be sure to give women equal voice in the discussion! Facilitate discussions of organisation of labour. True ownership of the DSM will be achieved if overall construction follows a free labour scheme, because then people will fully realise that the construction belongs to them.
- If food-for-work is used it must be done with the support of the PADO. Explain the procedures fully and ensure that the respective PADO representative is present to answer questions.
- In the case of food-for-work schemes, help to negotiate the community contribution in terms of labour and / or other ways. Again, the higher the community's contribution, the more ownership they will feel.
- Be sure to remind participants that community by-laws must be developed prior to construction starting, and explain why – see the by-laws section in order to understand this fully.

Discuss and verify during the meeting clear definitions of roles and tasks of the different stakeholders during each of the planning, construction, utilisation and maintenance stages. In other words, who will do what?

- What is the role and task of the DA?

- What is the role and task of the community representatives (Kebele leader, clan leader, elders)?
- What is the role and task of community members?

Final area selection

A second or final site selection might take place with community representatives and the NRM expert of the PADO on the basis of the resource mapping and results of the meeting. Be sure to join this final selection process and oversee the demarcation of the proposed dry-stone structure(s).

Second community meeting

Call for a second community meeting, using also local information systems such as daagu.

Remind the community what was discussed in the first meeting and what has happened since. Keep them informed and answer their questions! Then explain clearly, together with the kebele or clan leader and elders, the final plan in terms of how many structures are planned, where they will be situated, and the justification / explanation for this.

Further activities

- Ask the community not to remove the demarcation sticks and remind them again of the time schedule.
- When mobilising and organising the community contribution, remember that the larger the better! Register community members' names for participation in the construction. If food-for-work is being provided by the PADO, help to register all interested community members.
- Repeat community awareness creation meetings with those who were not able to attend the main meeting. Also use market days and festive days to meet people and to talk to them informally.

Training

In consultation with the kebele representatives, select about ten community members who to be trained as group leaders of their working teams. Select the most active and enthusiastic community members and ensure 50% women participation.

Organise the group-leader training with the PADO, which, in turn, can approach an executing agency if suitable expertise is not available at the PADO to organise and deliver this training

LAP-Test

Name	
Date	
Time started	
Time finished	

General Instructions:

- This practical test covers “Community awareness creation and area selection” Learning outcome” of DMs module.
- You are to accomplish the tasks provided in the specific instructions.
- You are given 2 hours to complete them.
- All your questions and clarifications should be addressed to the teacher only.
- Submit the documented results of your tasks to your teacher upon completion.

Tasks

1. Prepare the necessary resource requirements for Community awareness creation and area selection operation.
2. Organize and facilitate community meeting and capacity building.
3. Conduct a transect walking. Consider:
    a. Observation
    b. Discussion
    c. Note down (record information)
    d. Participatory mapping
4. Finalizing and reporting the selected areas for DSM

Learning Outcome 3: Constructing Dry-Stone Structures

By working through this Learning Outcome section:

- You will understand each step of building a dry-stone structure.
- You will understand your role and how to lead and guide the community in construction.

Instruction Sheet for Teachers

1. As usual, start by reading through the introduction; what do we want to achieve from this Learning Outcome?
2. Before starting with the Information Sheet, ask the students to describe all steps that have already been completed by the different stakeholders and by the DA.
3. Look at Information Sheet,. Go through each construction step, one by one, using the illustrations. Then go through the guiding questions and ask students to try answering them, especially the more technical questions. If you think it is necessary and helpful to increase memorisation of the construction steps, think of your own additional questions to ask.
4. Work through Operational Sheet. Nominate students to read aloud the different points listed. Stop after each point or operation and ask students to explain what is meant and why, in their own words. This interactive teaching will help students to memorise the topic better.
5. Take the students out of the classroom. Depending on the college surroundings, go to a potential dry-stone structure if possible. Discuss with your students and other teachers how to rehabilitate a micro-

watershed, or otherwise make some practical exercises of the construction steps.

6. Finalise Step Four outside. Work on the guiding questions of Operational Sheet and discuss especially on the role of the Development Agent.

Teaching methodology

Brainstorming, interactive teaching and learning, discussions.

Session Plan

- 10 minutes for the introduction and the brainstorm
- 60 minutes for the Information Sheet – construction steps
- 60 minutes for the Operational Sheet.
- 60 minutes (or more if necessary) for the outdoor exercise
- 10 minutes for the guiding questions.
- Altogether: 200 minutes (minimum).

Instruction Sheet for Learners

1. Read the introduction.
2. Work through the Information Sheet and note down any clarification questions, you might have.
3. Ask support from your teacher to get answers to your questions.
4. Try to answer the guiding questions and discuss them as well with classmates.
5. Note down any extra questions for your teacher and make sure you get the answers from them afterwards.
6. Complete the Self-Check Test.
7. Work through the operational Sheet and again try to answer the guiding questions.
8. Carry out the LAP-Test.

Information Sheet

If you have worked through Learning Outcomes One and Two thoroughly, you will know that a lot is finalised before construction itself begins, for example:

- Community awareness creation and decision making have happened;
- Site selection has happened;
- The community has developed their own by-laws and developed a community action plan;
- Community members have been organised to carry out the physical construction work (or food-for-work procedures with free community contribution);
- Demarcation has been finalised by the DA and/or the NRM expert from the woreda PADO office.

Once all of these are in place, construction can begin. It follows the sequence described in the construction steps below.

Steps for building dry-stone structures

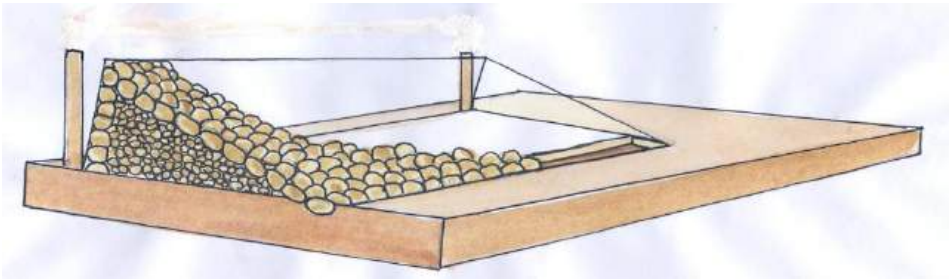


Illustration 12: Drystone structures are built like a triangle, forming a low wall with a slight inclination towards the hillside and decreasing height to the valley side.

Setting out

Setting out is demarcating the position of the dry-stone structure that is planned. Setting out is done in a straight line, at 90° to the gully and using a spirit level. If

there are a few small gullies apart from each other, it might be best to place the dry-stone structures only within the small gullies to have an overall water-spreading effect.

Wooden sticks are used to mark the horizontal upper line of the dry-stone structure. A rope is spanned over the whole length and fixed with the sticks. For short structures, no rope and sticks are necessary: they can be constructed ‘by eye’.

Illustration 13: Demarcation of the drystone structure

There is no need to follow the contour lines because the height of the structure varies with the depthof the riverbed or valley any way, forming the contour automatically. The width of the dam depends on its height. Width will increase

with height at a ratio of 1:3 to 1:5, depending on the slope and quantity of water flow expected.

Example:

The upstream-facing side of a dry-stone structure shall be 0.5 m high on the normal valley floor. Further on, there is a gully that is 1 m deep (measured from the upper line to the bottom of the gully). Following a ratio of 1:3, the width of the dry-stone structure will be 3 m at the deepest point (or 4 m or 5 m, depending on the expected water flow).

Transporting stones to the demarcated DSM sites

Before the construction begins, at least 50% of the stones needed should be on site. See the Operational Sheet for details on stone quantities.

Mathematical calculations of the catchment area are not a precondition for construction: visual observation and experience of local experts and community leaders is often enough. If calculations of the catchment area are made, however, they should be done in coordination with the PADO.

The dry-stone structure will have different widths depending on its specific height above ground. It follows a horizontal line and automatically forms a triangle at the deepest point, as shown in Illustration 14 and Illustration 15.

Illustration 14: A drystone structure is spanning the valley, forming a horizontal line. The width is increasing with the height of the structure, especially in the gullies

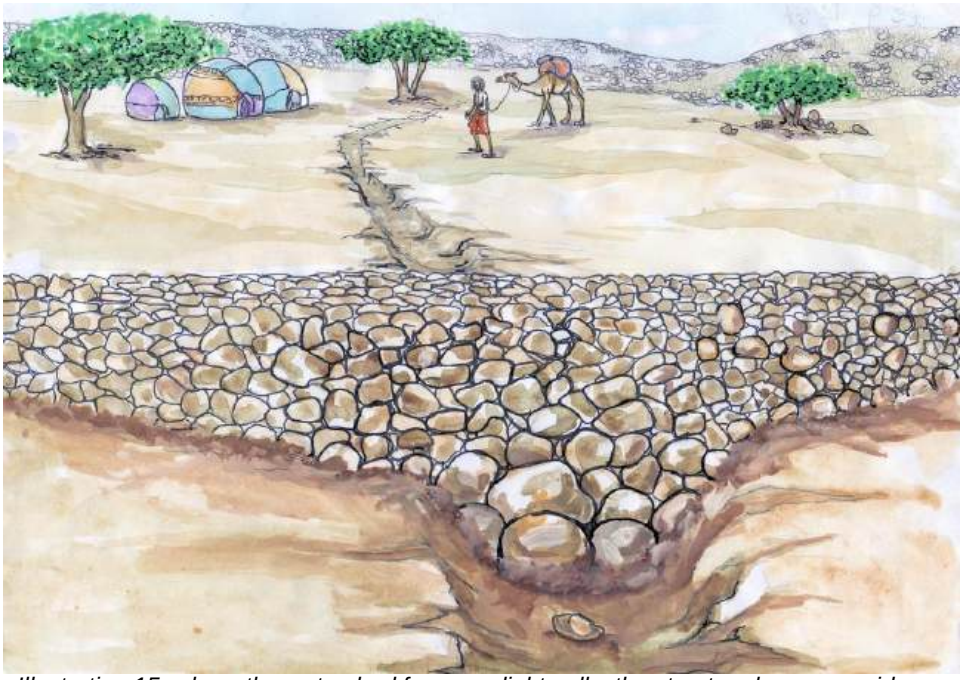


Illustration 15: where the watershed forms a slight gully, the structure becomes wider, forming a "triangle" at the deepest and widest point

Constructing the basis

Begin by placing big stones below the rope that is demarcating the upper border line of the structure. Excavate along the wooden sticks along the bottom, approximately 30cm deep and 30cm wide. Only the last stone row should be dug in – see Illustration 20. All other stones are just filled into the structure. At the bottom place gravel or small stones, whatever is locally available – see Illustration 16.

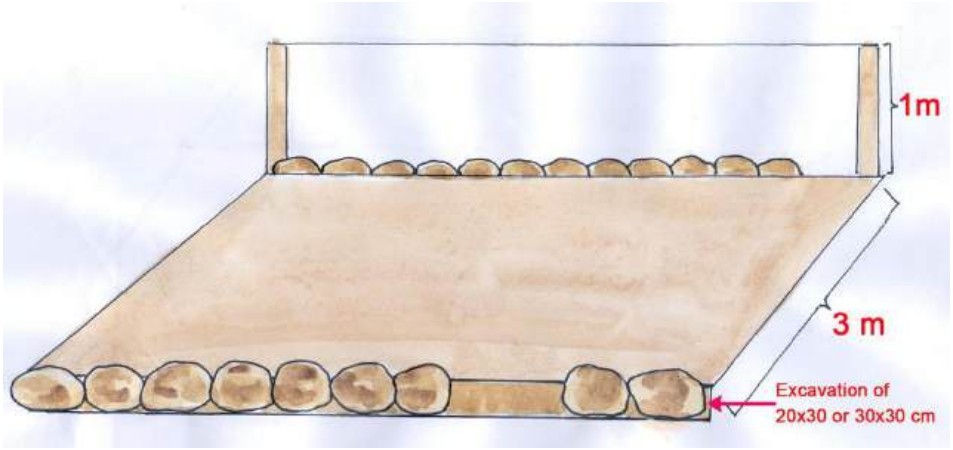


Illustration 16: Schematic illustration of the start of a Drystone Structure construction: Big stones along the upper line. Big stones dug into the soil at the bottom line.

Filling up the wall and making it higher

Smaller stones should be used to fill over the whole width of the structure. Another layer of big stones should follow along the upper line, meanwhile, with a slight inclination, as in Illustration 17. Due to inclination of the front wall, the upper stones do not touch the rope. Small stones will be filled in, decreasing in height towards the lower line of big stones, as shown in Illustration 18.

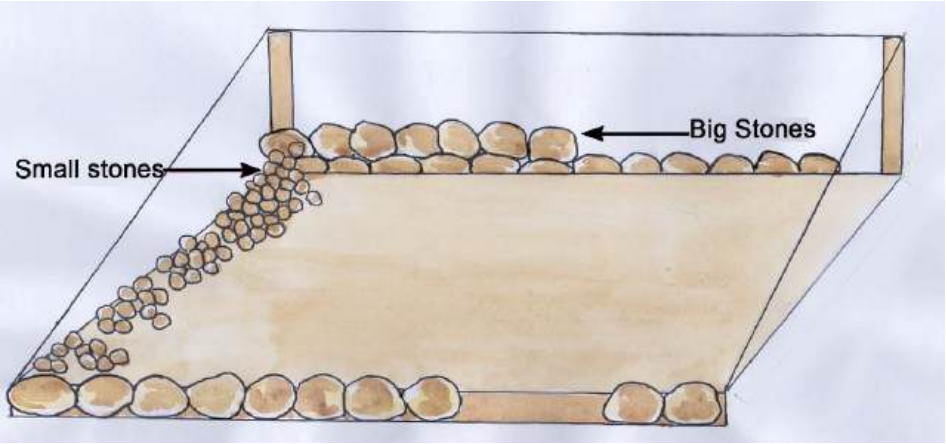


Illustration 17: Schematic design of the stepwise construction of a dry-stone structure

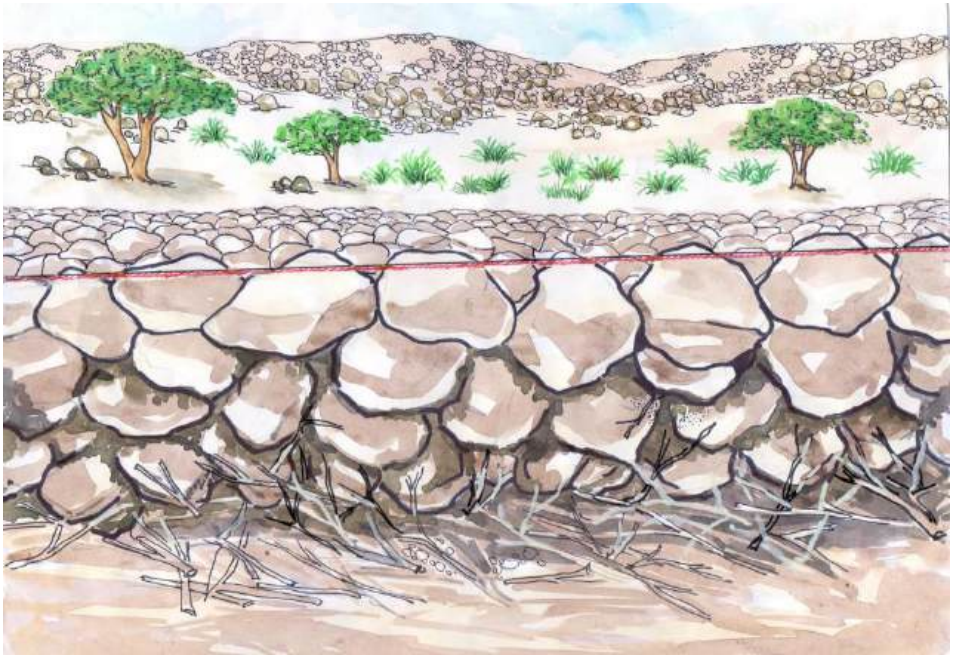


Illustration 18: The construction seen from upstream. The wall made of big stones, the rope demarcating the upper straight line of the dam. Small stones in the back indicate that the construction is not yet finished. A cover layer of big stones is missing.

Placing the cover layer of big stones

Once the planned height is reached, and after the structure has been filled with smaller stones, cover it with big flat or big round stones from the top to the bottom and over the whole length of the structure. Once the whole structure is covered by big stones, and if the structure can be walked over without the stones moving, this is a sign of sufficient stability.

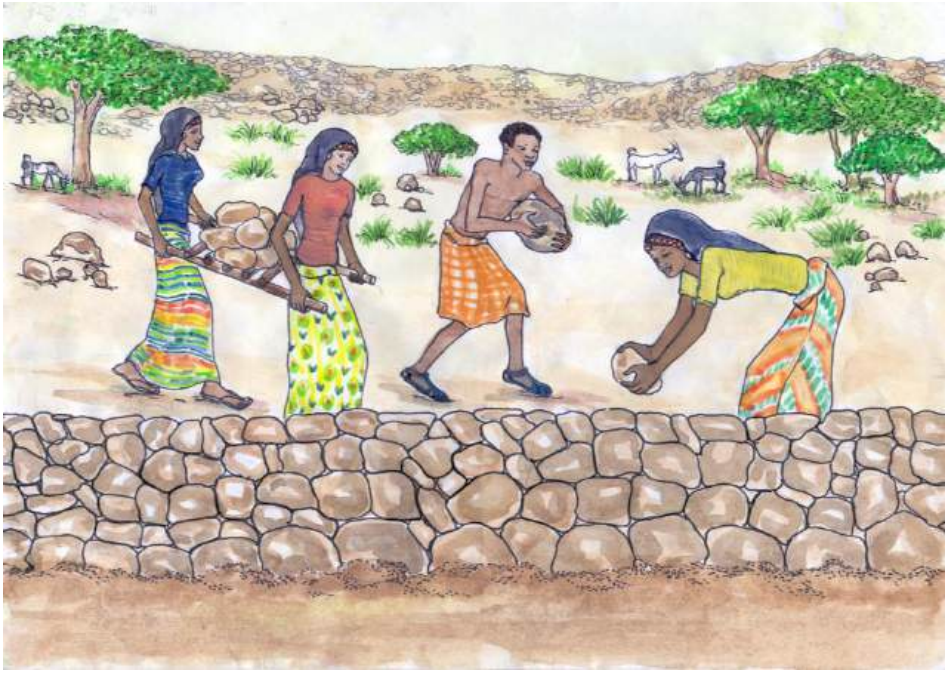


Illustration 19: Drystone structure, almost finalized. Women and men bring big flat stones to cover the small stones.

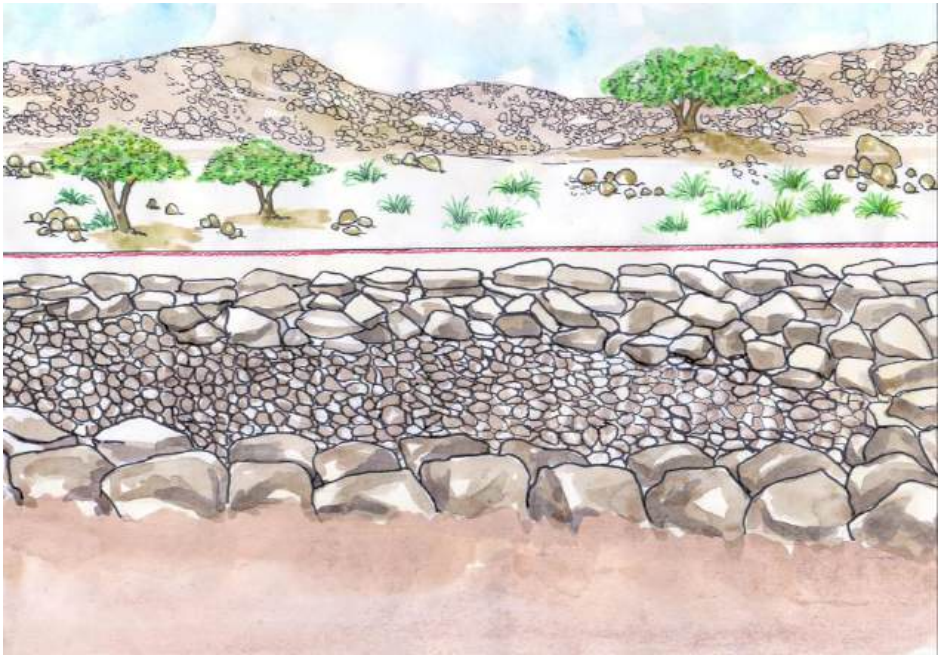


Illustration 20: View from downstream of a not yet finalized drystone structure: it is almost finished: Big stones dug into the soil mark the bottom side of the structure. Above, small stones are used for the filling. Large flat stones cover the upper part already. They are still missing in the lower part. The rope indicating the straight line is still in place.

Once the whole structure is covered by big stones, it is finalized.

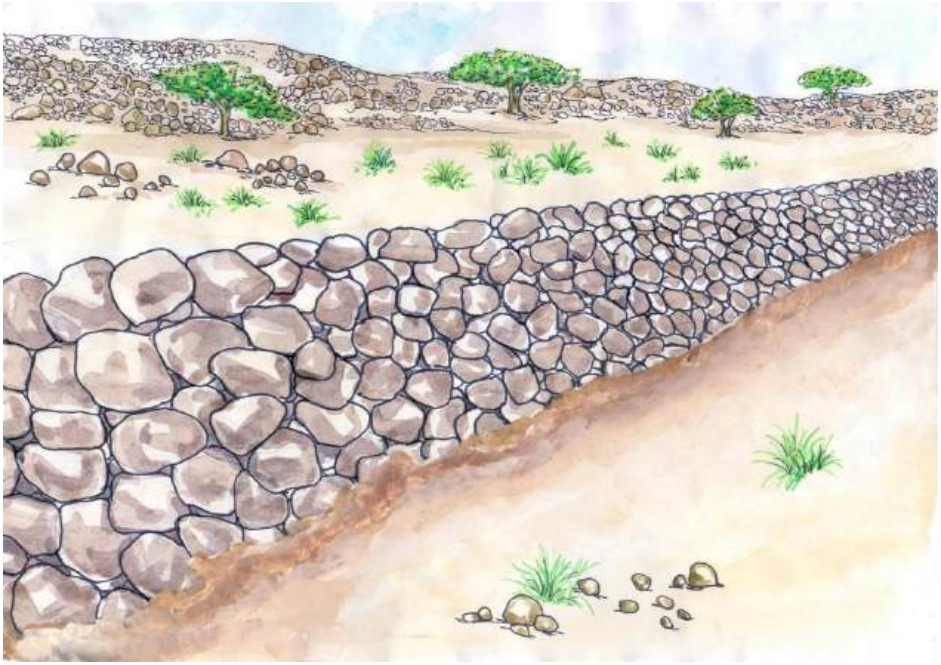


Illustration 21: finalized drystone structure

Guiding questions for discussion

1. Describe the main steps of construction of a dry-stone structure.
2. What is the ratio between height and width, and what is the reason for this particular ratio?
3. How are (i) direction of water flow and (ii) water infiltration modified by DSMs?
4. List all of the inputs or resources needed to build a dry-stone structure.

Self-Check Test

Name	
Date	
Time started	
Time finished	

Instructions

Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1. Mention the steps of dry-stone construction. (6 points)
2. Which preconditions need to be accomplished before starting the construction of a dry-stone structure. (5 points)
3. Please specify all the resources required for construction of a dry-stone structure. (5 points)
4. Show by sketching the simple technical profile of dry-stone structure. (5 points)
5. Explain the importance of big stones in construction of a dry-stone structure. (4 points)

Note: Satisfactory rating – 20- 25 points Unsatisfactory – below 20 points

You can ask your instructor for a copy of the correct answers.

If your answer differs from that of your instructor for a very single point do not proceed to the next learning, rather better work on the same information sheet until you acquire all the necessary information.

Operational Sheet

As the DA of the kebele you will lead and oversee the entire construction process. This includes attending and observing the training given to some community members prior to construction.

Objective

The selected area is rehabilitated by dry-stone measures.

Construction Process

Your work will be much easier and more successful if the kebele leader and the DAs for animal production and agriculture are all on board and actively involved. Talk to them, answer all of their questions and generally make sure that they fully understand the benefits and process of DSM implementation and maintenance. By doing this you set up a 'leading team' which works together, shares responsibilities and has bigger reach.

Remind the community a few days ahead on the combined date and time for the start of construction, the number of working days and the working hours involved, the participants and the type of work to be done by different groups of people. Especially clarify to community the tasks of the trained community members in terms of supervision, managing shifts, break times and mealtimes.

Construction work is typically performed by teams of five to ten. Each team is led by a group leader, with specific activities existing for each team and lasting a specific time (such as 15 days). It is possible to train an entire community in DSM

implementation: team leaders spread the skills and a rotation gives people a break and involves more people, increasing ownership.

Before embarking on any stage of implementation, double-check that everything is organised and in order before starting. This avoids delays, uncertainty and complaints later on.

Resource Requirements

- spirit level;
- wooden sticks;
- rope/string;
- means for transportation (barillas, donkey charts, wheel barrow);
- hand tools: shovel, pick axe, crow bar;
- optional: meter;
- big and small stones. Quantities depend a lot on the height and width of the structures and the landscape;
- labour force: this depends on the level of community organisation, mutual encouragement within the community and the supervision by DAs and kebele representatives.

Setting out

Using the spirit level, 'set out' with the support of the other DAs, the PADO NRM expert and the group leaders from the community. Demarcate with the wooden sticks. Some community representatives and the group leaders should join this work too in order that they can guide others later on when the activity is repeated.

1. Stretch out the rope / string between the wooden sticks (as in Illustration). Ensure that nobody is touching the rope in order to avoid construction errors. After each working day, ensure that the rope is removed so that it doesn't trip passing people or animals. Respanning the rope in exactly the same way between the sticks is then the first thing to do the next morning.
2. Use a meter ruler or a correctly cut wooden stick measure to calculate the width of the structure. 1 metre in height corresponds to 3-5m in width.

See Illustration 26. Make the structure wider wherever the landscape forms a gully or when you expect a larger amount of water flow. From the upper line, measure the depth. Calculate the width at this point (eg. 0.6 m deep – 1.8 m wide or 1 m deep - 3 m wide at the deepest point – see example in the Information Sheet.

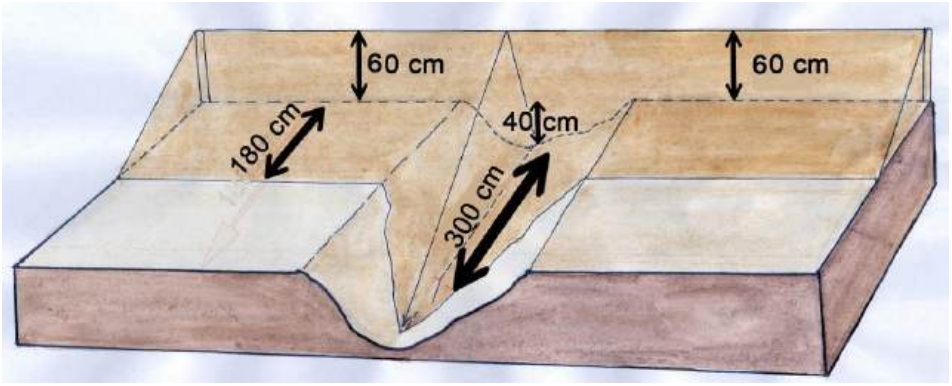


Illustration 22: Taking measurements

Organising stone collection

At the same time as setting out the dry-stone structure, organise the collection of stones. Divide the participants into groups of around 10 people, with each group represented by a group leader.

Make sure that slope erosion is not dramatically increased by the removal of stones.

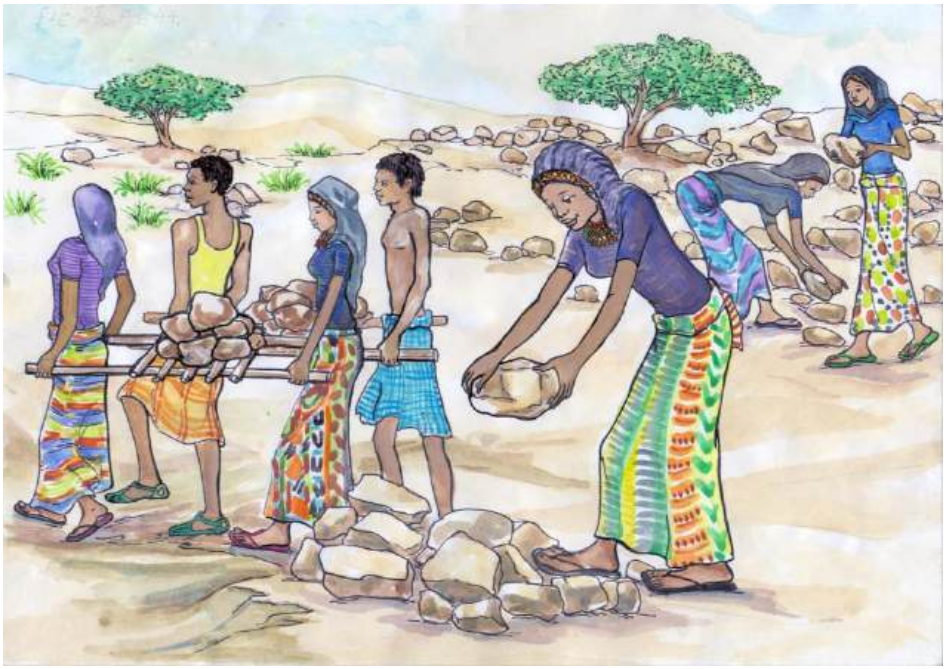


Illustration 23: Women collect stones nearby the construction site.

Organising transportation of stones

At least 50% of the stones that are calculated to be needed should be at the site before stone placing even starts. This to avoid any risk that labourers are left waiting for stones and waste their time.

.

Illustration 24: You can use donkey carts for transport of stones, if they are far away and heavy

Illustration 25: Women and men can carry stones by simple traditional means, if stones are found nearby the construction site and stones are not too heavy.

Build the structure

1. Ensure that large stones are placed with firmness and stability along the upper line of the dam.
2. Digging the stones along the bottom line of the structure is essential. Ideal stone size is 20-30cm diameter. Dig them in, not into the soil totally, but about halfway below and above ground level.
3. Organise the working teams to fill smaller stones over the whole width of the structure. The teams can either work on several structures at a time or on one structure by dividing it into sections. The group leaders should ensure that each group member has a specific task, and that the construction steps are being followed in the correct order. Ensure that the small stones decrease in size and height towards the lower line of big stones in a triangular shape – see Illustration .
4. This second layer also follows the upper line, but with a slight inclination. Again, fill this layer in with small stones around it in order to add stability.
5. Repeat Steps 3 and 4 as many times as necessary until the structure is as high as the setting-out rope.
6. Covering the whole structure with a layer of large, flat stones is the final stage of construction. Their arrangement should be sufficiently firm and stable that the structure can be walked on without stones moving underfoot.

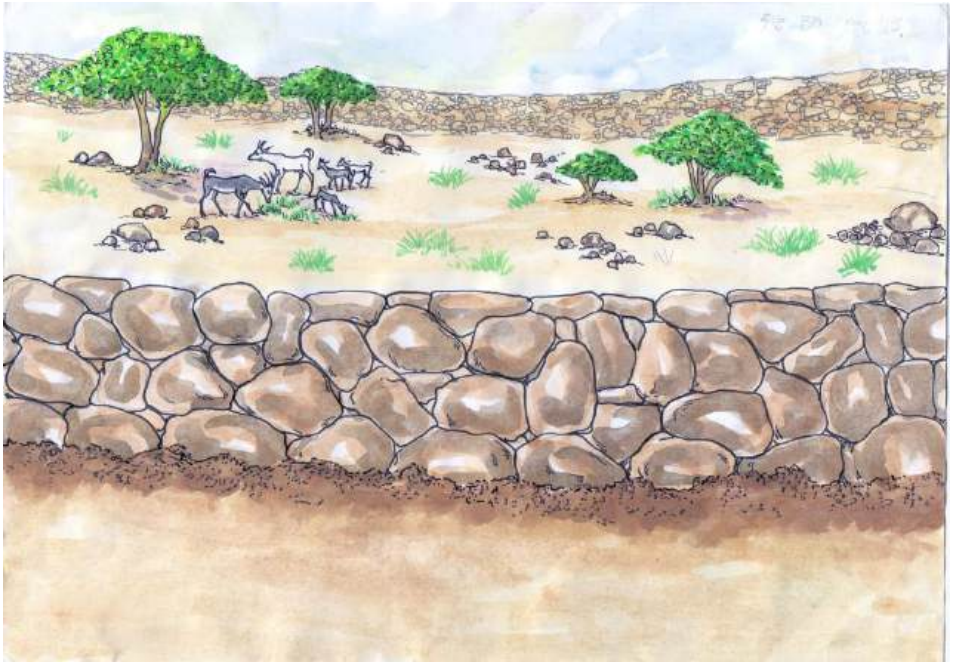


Illustration 26: Big stones are dug into the soil at the bottom line. The upper half of them is visible.

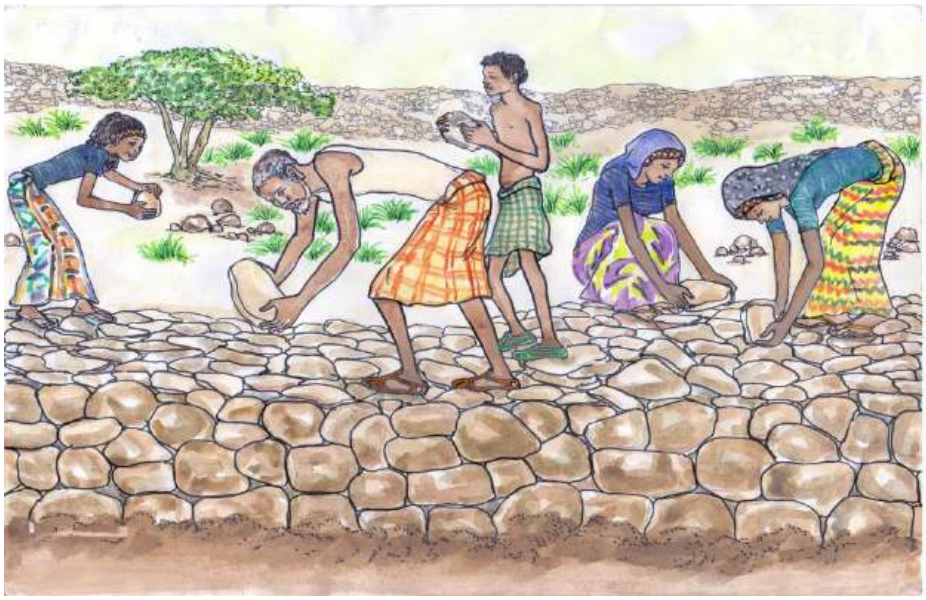


Illustration 27: community member covers the dry-stone structure with flat stones

As well as guiding and overseeing the construction work in a positive and interactive way, support the teams around you by explaining things clearly and repeatedly and answering any questions that community members have. Never be bossy when giving instructions, and if giving orders, explain clearly the reasons for everything.

Talk to team leaders regularly and follow up on their work closely, including ensuring that they respect their working days times, and that the work they do is thorough and quality. Work with the kebele leader to achieve this. Also, regularly remind community members about their required contribution and the collect benefits of the structure.

Continue to spread awareness about DSMs and encourage communities to actively utilize the fertile and moist land above, between and below the dry-stone structures. Also, support and oversee structural maintenance after every rainy period.

Illustration 28: Brief discussion with the community members in a break.

Guiding Questions for discussion

1. What is the role of the Development Agent during the construction process?
2. How do you claim up the upper and the bottom line of the structure?
3. What is the role of PADO in the construction process?

LAP-Test

Name	
Date	
Time started	
Time finished	

General Instructions:

Given necessary equipment, tools, and materials required to perform the following tasks within 4 hours. Write down your answers on an extra sheet and submit to your instructor.

Tasks

1. Identify and collect the equipment and tools required for dry stone construction (2 points)
2. Clean the site that is selected to construct the structure (2 points)
3. Using the given tools, set-out the place where the structure to be constructed (3 points)
4. Construct a specified section of the base by starting with putting big stones below the rope (8 points)
5. Construct the specified wall section higher by filling the smaller stones over the whole width of the structure (5 points)
6. Put the cover layer of big stones from the top to bottom and over the whole length of the specified Drystone structure section (5 points)

Note: Satisfactory rating – 20-25 points. Unsatisfactory - below 20 points

Learning Outcome 4: Biological Protection and Maintenance

By working through this Learning Outcome you will deepen your knowledge and understanding of:

- the strong links between biological protection and maintenance of dry-stone structures;
- various biological protection measures;
- how to guide and support the community in implementing biological protection;
- the crucial role of the Development Agent in the process.

Instruction Sheet for Teachers

1. Start by reading through the **introduction with the specific learning objectives.**
2. Ask your students: In what ways can the land around a dry-stone structure be protected with biological measures? Give them five minutes to draft an answer to the question, either alone or discussing and taking notes in pairs or small groups. Then ask them to read out some of their answers.
3. Read through the **Information Sheet: Biological Protection**, asking the students to read aloud and discussing the content in relation to the answers they have previously given.
4. Now repeat the procedure, asking your students: What occurrences and processes will cause your dry-stone structures need maintenance? Give them five minutes to draft an answer to the question, either alone or discussing and taking notes in pairs or small groups. Then ask them to read out some of their answers.
5. Read through the **Information Sheet: Maintaining Dry-Stone Structures,** asking the students to read aloud and discussing the content in relation to the answers they have previously given about maintenance.
6. Discuss the guiding questions at the end of the **Information Sheet: Maintaining Dry-Stone Structures.**
7. Based on what you have read through **Information Sheet: Biological Protection** and **Information Sheet: Maintaining Dry-Stone Structures**, discuss with your students how they might plan to implement biological protection measures and DSM maintenance.
8. Now read through the **Operational Sheet**.
9. Divide your students into groups of four and tell them to role play a community discussion on a either biological protection measures or DSM maintenance. What plant species might be used? Where and when might they be planted? How will they divide labour? How often will they maintain the structures?... If you want you can assign a specific role to each group member. Examples of scenarios might be:

a. Somebody reluctant to participate in repairing a structure;

b. Somebody reluctant to participate in area enclosure;

c. Somebody wanting to leave everything to the PADO and the executing agency;

10. After 10-15 minutes of role play, ask each group to present a summary of the main points discussions held, including any consensus met or conclusions drawn.

Teaching methodology

Brainstorming, interactive teaching and learning, role plays.

Session Plan

- 15 minutes for the Specific Learning Outcome and brainstorm
- 20 minutes for the text on utilization in the **Information Sheet: Biological Protection**
- 15 minutes for the brainstorm on maintenance
- 20 minutes for the text on maintenance in the **Information Sheet: Maintaining Dry-Stone Structures**
- 20 minutes for the guiding questions
- 15 minutes for the brainstorm - prior to working on the **Operational Sheet**..
- 15 minutes for working through the **Operational Sheet**.
- 30 minutes for the role play, including preparation and follow-up discussion.
- **Total: 150 minutes**

Instruction sheet for Learners

1. **Work through** **Information Sheet: Biological Protection** and **Information Sheet: Maintaining Dry-Stone Structures**. Note down any questions of clarification, that you have;
2. Ask your clarification questions to the teacher;
3. Complete the Self-Check-Tests at the end of **Information Sheet: Maintaining Dry-Stone Structures**;
4. Discuss each of the guiding questions with your classmates;
5. Continue with the **Operational Sheet**;
6. Once again, try to answer each of the guiding questions;
7. Carry out the LAP-Test.

Information Sheet: Biological Protection

With the first rains, changes will take place quite fast around a new dry-stone structure. For example, sedimentation above the structure and flooding of water both upstream and downstream will be immediately visible. Biological protection is an essential step, being perhaps the cheapest, most natural and therefore sustainable way of fixing and firming up a structure quickly, as well as making use of infiltrated water and sedimented fertile soil. Area enclosure and planting of trees, shrubs and grasses are easy forms of biological protection that benefit communities. In spite of the obvious benefits, community members might remain hesitant early on, observing rather than acting until they are fully convinced of the benefits.

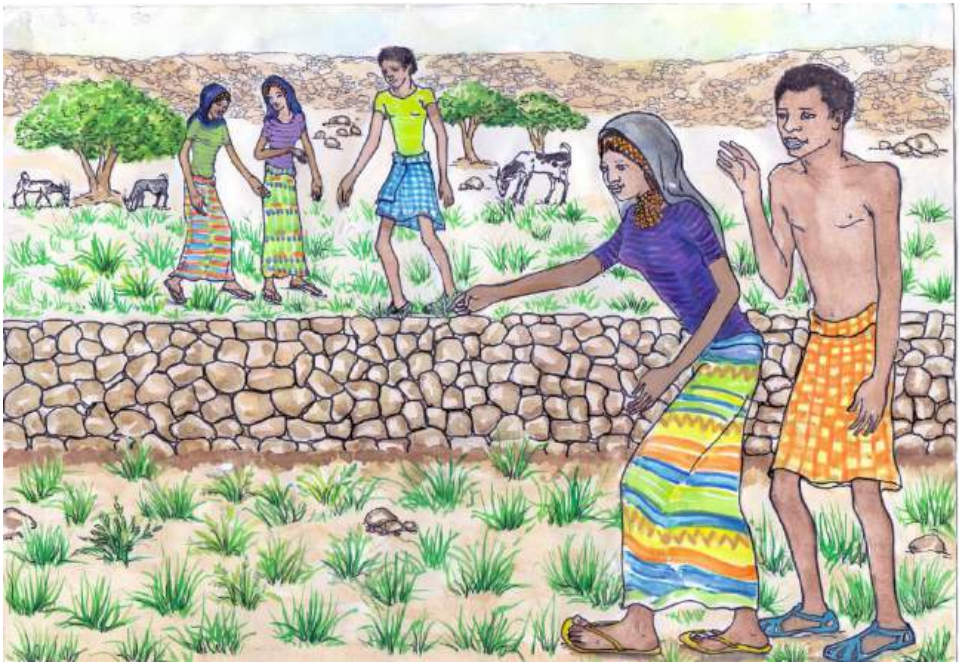


Illustration 29: after only one rain, the land can look like this. Moist soil with sedimentation upstream of dry stone structure. Grass and herbs start growing again – upstream and downstream.

An enthusiastic Development Agent and an active kebele or clan leader are essential for encouraging people to contribute to biological protection measures. Quick and visible benefits, in turn, are necessary to motivate people to continue to collectively maintain structures themselves.

Community awareness creation comes into play again here. At this stage the Development Agent should support looking back into the by-laws. What has been agreed in terms of biological protection? What is possible without any external inputs and support? There list below might is not a comprehensive set of options: community members might suggest or find out appropriate and effective forms of use and protection forms not listed here.

Area enclosure

Agro-pastoralists can fence the area traditionally to avoid uncontrolled livestock grazing. Natural regeneration of grasses and shrubs can happen undisturbed from animals. The closed area can be kept for future grazing, when dry soils in the surroundings do not provide fresh grasses anymore. Or, a cut and carry-system of grasses can be practiced to feed animals around homesteads. Alternatively, seed production of those grasses which are appreciated locally, and enrichment of the grazing area can be executed. You, as the Development Agent, will advise on these practices. Additional seeds or cuttings could be arranged by PADO; such as the vigorous elephant grass.

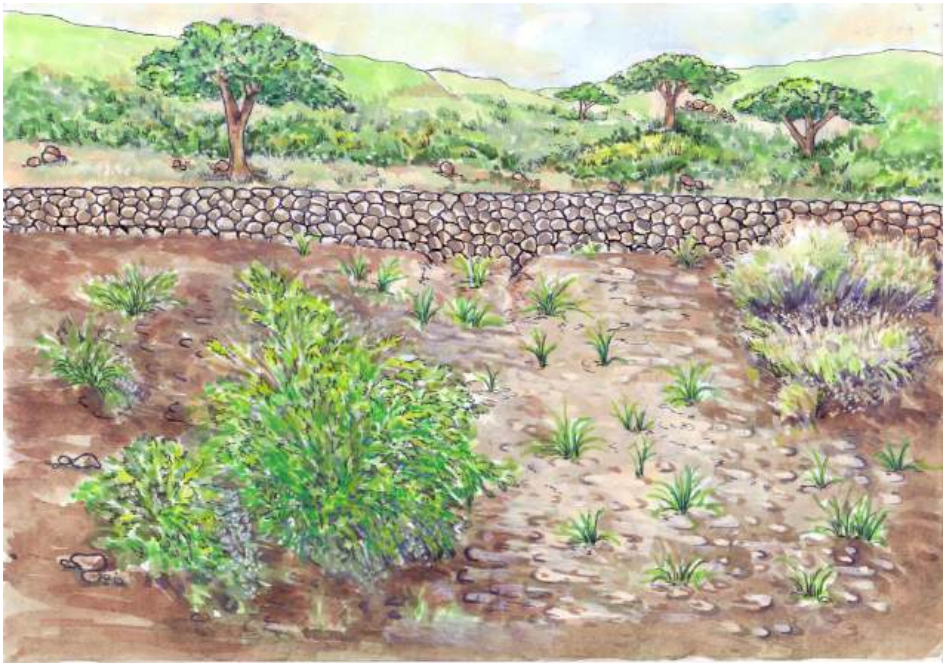


Illustration 30: Upstream of the drystone structure: fertile and moist soil with natural regeneration of grasses and shrubs

Planting of trees and shrubs, fodder planting

Trees and shrubs, planted as a biological conservation measure, stabilise ground through their rooting systems. Cattle, camels, sheep and goats benefit from protein-rich shrubs or trees, and shade from the sun is produced for both humans and animals.

Plants such as the easy-growing, drought-resistant pigeon pea, are protein rich and fix nitrogen into the soil. Branches can be used as fodder for livestock while the pigeon peas themselves provide a healthy meal for humans.

For example:

Interviews conducted in Afar Region revealed that the most important tree species for grazing there, which are all palatable to all livestock species, are Hiddayito, Medira, Keselto and Uddayito. These can all be planted above and below dry-stone structures, feeding off the increased captured water in order to establish themselves and grow

Agricultural use

Varieties with short vegetation periods are important for agro-pastoralists so that they can be harvested before people migrate to other areas. As the DA you should be able to advise on correct planting techniques and correct agricultural practices. You must also liaise with the PADO if specific seeds are needed and you must support selection, improvement and multiplication of local seed varieties.

Information Sheet: Maintaining Dry-Stone Structures

Rainwater percolates through a dry-stone structure, and fine organic matter transported by the water duly compacts and stabilise the structure from inside. On the other hand, large branches or inorganic waste such as plastic interrupts smooth water flow, diverting it unnaturally to cause erosion or even to render the structure dysfunctional until it is fixed. Maintenance is therefore crucial to ensuring that the structure is secure and continues to benefit both livestock and people. It should be recognised that maintaining dry-stone structures is very easy due to the local availability of materials which are laid naturally without the need for cement or other relatively costly inputs.

Maintaining a dry-stone structure typically requires:

- the removal of bigger branches and waste carried down by rainwater;
- putting back all stones that have been moved or carried away by heavy rain;
- wherever the structure has been overflowed by water causing damage to ti, its height needs to be increased or another dry-stone structure constructed higher up the slope.

Dry-stone structures generally need more maintenance in their early stages, soon after construction. The need for maintenance becomes less over time as the sedimented soil within the semi-permeable structure contributes to stabilisation and the structure becomes more compact.

All of the rules, requirements and proceedings for maintenance will have already been decided upon and detailed in the by-laws. At this point it is therefore necessary to look back into the by-laws together with the community so that they can remind themselves of what they agreed upon previously. The organisation of maintenance can be different from community to community. While some communities might set up a ‘permanent’ maintenance team, others might prefer a rotating system.

For any dry-stone structure a small maintenance committee, of which the DA should definitely be part, should do regular monitoring checks (especially after each heavy rainfall) in order to check on the physical structure. Stones which have been moved or washed away by the floods must immediately be replaced.

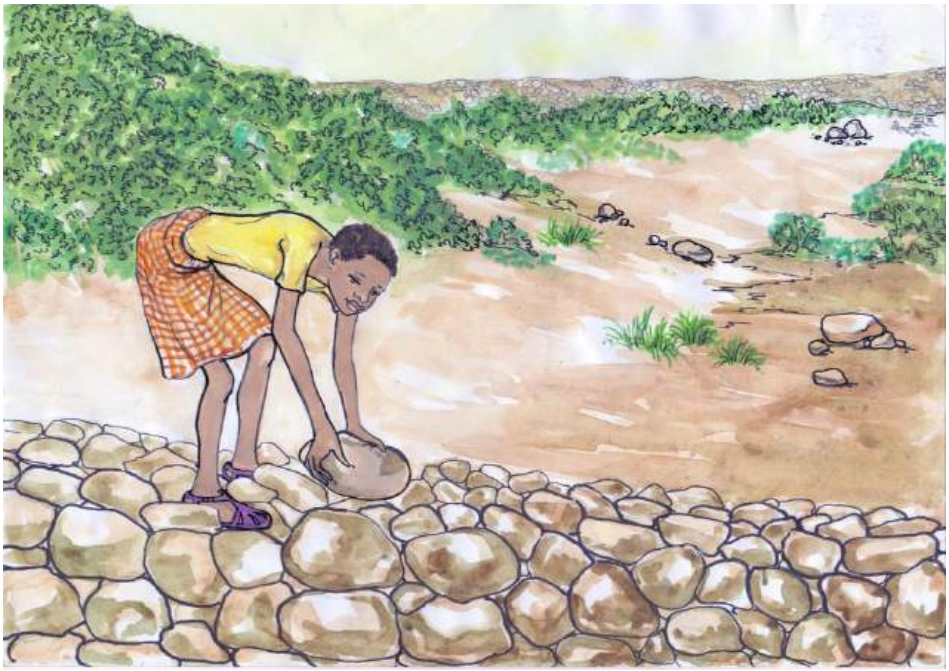


Illustration 31: A young boy is putting back a big, flat stone that was washed away.

Should a maintenance system prove unpractical or not deliver the agreed outputs, by-laws should be allowed to be modified at any time by the community.

The more people use and benefit from the land protected by a DSM (or the DSM in combination with a Water Spreading Weir), the more they will have own interest in maintaining the structures.

Development Agent's responsibilities regarding maintenance

- Remind, advise and mobilise people based on their consensus decisions, as captured in the by-laws;
- If a problem arises that is too serious to be solved by the community alone, link them to the Woreda PADO office;
- Be an active part of the maintenance committee, and always make people aware of the need to maintain dry-stone structures regularly.

Guiding questions for discussion

1. What is the advantage of biological protection?
2. List examples of biological protection.
3. What are respective roles and tasks of the Development Agents for NRM, animal production and agriculture?
4. Why should all three DAs for a community work together?
5. Why is community awareness creation important at this stage?
6. What is the task of the maintenance team?

Self-Check Test 'Biological Protection' and 'Maintenance'

Name	
Date	
Time started	
Time finished	

Instructions

Answer all the questions listed below. Write your answers in the sheet provided separately. Write your answers in the sheet provided in the next page.

Part I: Choose the correct answer

1. Which of the following is true about biological protection and maintenance of dry stone measures? (1pt)

    a. Strengthen the structure
    b. Use dry stone
    c. Planting dry wood
    d. Planting any wood

2. In any causes of damages, the maintenance of dry stone structure usually comprises of: (1pt)

    a. The removal of tree branches and waste carried by the rain
    b. The putting back of stones carried away by heavy rain
    c. The need to decrease the height, in case a dry stone measure taken by water
    d. The construction of another structure in case a dry stone measure is taken by water.

3. The roles of Development Agents in the maintenance of dry stone measure is to: (1pt)

    a. Advice the local community
    b. Link up to the Pastoral Agriculture Development Office
    c. Be a more active part of the maintenance committee
    d. Be a more observing part of the maintenance committee

Part II: Matching

Listed below are different terms used in biological protection of Dry Stone Measures. Match column A with column B. Use each letter only once and write it in the blank space provided (1 pts each).

Insert letter	Column A
	Multiplication of local seed varieties
	Cut and carry system
	Planting of multipurpose trees
	Bye-Laws

	Column B
A	Biological protection
B	Area closure
C	Agricultural use
D	Decision making

Part III: Short Answer

1. List at least three actors who are involved in the continuation of biological protection and maintenance of dry stone measure activities within the community (3 pts)

2. Explain mechanisms how Agro-pastoralist can utilize the area created by the dry stone measure (3 pts)

3. What are the roles of development agents in maintenance activities of dry stone measures? (3 pts)

Note: Satisfactory rating points 15 and above. Unsatisfactory below 15.

You can ask your instructor for a copy of the correct answers.

If your answer differs from that of your instructor for a very single point do not proceed to the next learning, rather better work on the same information sheet until you acquire all the necessary information

Score:

Rating:

Operational Sheet

Dry-stone structures directly benefit agro-pastoral communities, who themselves actively maintain the structures.

As the Development Agent, you will provide technical advice on land use options. As a facilitator and community organiser you must ensure that NRM maintenance work is done regularly and properly.

Procedure

1. Together with the kebele or clan leader, call for a community meeting immediately upon finalisation of a DSM's construction.
2. Facilitate the discussion on use and maintenance of land by reminding people what was agreed upon in the by-laws, starting from utilisation.
3. Give women a say. What was agreed? Who will use which land now, and how?
4. Which kinds of technical support are needed from the DA? If the (common) request for external supply of seeds and inputs is made, ask instead, what can be done with the resources that are locally available?
5. What should done most quickly? Organising local seeds? What should be done as soon as the rains come? What should be done after the first rain?
6. One person should take notes and write down the decisions.
7. Follow up the decisions after the meeting.
8. Call for a second meeting – or, if time allows, and depending on the community's wish – use the same meeting for a discussion on maintenance.

9. Look back into the by-laws. Are the by-laws clear regarding maintenance? Remind the community what the relevant by-laws say.
10. Organise the maintenance committee in terms of working time, rotations and responsibilities.
11. Carry out a first maintenance, including a DSM check, right after the meeting. Is everything fine with the structure?
12. Remind people also of the meeting intervals agreed upon in the by-laws and help them to decide on a date for the next meeting. These meetings should be used exclusively to discuss the biological protection, use and maintenance of the land around and between dry-stone structures. In light of this, it can be dealt with problems that arose or technical assistance that is needed from the DAs for agriculture, animal production or natural resource management.
13. Remind people about the date of the next DSM check, and / or agree to check as soon as it has rained.
14. Support maintenance activities, as explained in the Information Sheet. This includes follow up as to whether thorough maintenance has really happened. Continue community awareness creation for maintenance at all opportunities, during community meetings, meetings on by-laws.
15. Re-adjust as necessary.

LAP-Test

Name	
Date	
Time started	
Time finished	

General Instructions:

Given necessary tools and materials you are required to perform the following tasks within 1 hour.

Tasks

1. Prepare tools and equipment (2 points)

2. Identify tree, shrubs, grass and forage species for planting (3 points)

3. Carry out the survival rate of plantation and work out to recommend replacement for dead and unhealthy plants (5 points).

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

Glossary of Technical Terms

Arable Land	Land which is capable of being ploughed and used to grow crops.
Biodiversity	Abbreviation of 'biological diversity'. Variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Catchment area	The area from which rainfall flows into a river, lake, or reservoir.
Desertification	Land degradation as a reduction or loss in arid, semi-arid or dry sub-humid areas of biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, woodland etc. Desertification is caused by (i) wind- and/or water-induced soil erosion, (ii) deterioration of physical, chemical, biological or economic properties of soil, and / or (iii) long-term loss of natural vegetation and biodiversity.
Dry-stone measure (DSM)	DSMs are designed to reduce degradation, increase water infiltration and prevent (gully) erosion over large areas of land. They reduce the speed of water flow, retain organic matter and deliver a water-spreading effect. DSMs function best in combination with biological protection
Dry-stone structure	Dry-stone structures are semipermeable and made of natural stones only. They are built at right angles to a slope (ie. at right angles to the direction of water flow), forming a horizontal line along the upstream facing side. Series of structures can span a whole valley or they can be focused in

	small gullies in order to specifically slow gully formation and to disperse runoff.
Evaporation	The change by which any substance is converted from a state of liquid to vapour.
Groundwater	(1) Water content within the earth that supplies wells and springs. (2) Water contained in the zone of saturation, in which all openings in rocks and soil are filled and the upper surface of which forms the water table.
Gully erosion	A gully is a landform created by running water eroding sharply into soil on a hillside or slope. Gullies resemble large ditches or small valleys and they vary from being less than a meter to tens of meters in depth and / or width. When water flow rate is substantial, its cutting action into soil is deeper and more substantial. Gully erosion is a serious problem in arid and semi-arid areas where vegetative cover is poor. In Ethiopia, gully erosion is widely caused by runoff from untreated farmland, slopes, roads and urban areas.
Infiltration	The penetration of water through the ground surface into sub-surface soil.
Land degradation	A reduction or loss of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland or range, pasture, forest, and woodland.
LAP Test	Learning Accomplishment Profile Test, examined by an assessor.
Participatory resource mapping	Participatory resource mapping captures and represents – usually (but not necessarily) spatially, in map form – the resources available to a community within a given physical area. Mapping also captures and represents other physical features of relevance. Resources listed and placed on a map

	typically include slopes, water sources, water courses, designation of land use (such as fields or settlement) and vegetation types. Similar to a social or village map, a resource is not drawn accurately to scale; rather it is compiled collectively (in a participatory way) by stakeholders, based on their knowledge and experience of the surroundings (usually from having lived and worked there for a long period of time). A resource map reflects people's perceptions of the reality of their natural resources rather than precise measurements.
Pasture land	An area of land on which animals feed on the grass contained therein. Pasture constitutes both enclosed tracts of farmland which are grazed by domesticated livestock and open, unenclosed land which is grazed in a less regulated way by both livestock and wild animals. The vegetation of tended pasture often consists of grasses interspersed with legumes and other forbs (non-grass herbaceous plants).
Resilience	The ability of an ecosystem to maintain or restore biodiversity, biotic integrity and ecological structures and processes both during and following a disturbance event..
River basin	The area drained by a river and its tributaries.
Runoff	Surface water entering rivers, lakes or other reservoirs.
Sediment	Particles, derived from rocks or biological materials, which are suspended or settled in water, having been transported by a fluid or other natural process..
Siltation	The deposition of fine soil and rock particles on the bottom of streams, riverbeds and lakes or other reservoirs.
Slope	The side of a hill or mountain, the inclined face of a cutting, canal or embankment, or other inclination from the horizontal. The steepness of a slope can be expressed as a percentage, the term 'gradient' also being used.

Soil Erosion	The wearing away of the land surface by physical forces such as rainfall, flowing water, wind, ice, temperature change, gravity or other natural or anthropogenic agents that abrade, detach and / or remove soil or geological material from one point on the earth's surface to another. Soil erosion is normally a natural process occurring slowly over extensive geological timescales, but wherever the natural rate has been accelerated by anthropogenic activity, soil erosion becomes a process of rapid degradation and an immediate and identifiable threat to soil.
Spillway	A structure over or through which flood water or run-off is discharged. If the flow is controlled by gates it is called a 'controlled spillway'. If the elevation of the spillway crest is the only control, it is an 'uncontrolled spillway'
Stakeholder	Stakeholders are either individuals or groups that hold a real or a potential interest in a process or project and its change objective, and / or they are individuals or groups who are affected directly or indirectly in terms or power, privileges, business, livelihoods or physicality by the process or project.
Stilling Basin	A basin constructed to dissipate the energy of fast-flowing water, such as from a spillway or outlet, in order to prevent undercutting of a dam or other structure and in order to protect the streambed from erosion.
Sustainable development	A process of change or advancement that is considered to be both positive and meeting the needs of the present without compromising in any way the ability of future generations or entities to meet their own needs.
Transect	Also known as a 'transect walk'. This is a method used to explore the spatial dimensions of people's realities by factoring social aspects of a community into the layout of its natural and other resources. A transect is normally conducted following resource mapping the village in order to facilitate triangulation of the data generated on a resource map. The transect depicts a cross-section of agro-ecological zones and provides a comparative assessment of these zones in terms of topography, land type, land use, ownership, access, soil

	type, soil fertility, vegetation, crops, problems, opportunities, solutions and other parameters.
Tributary	A stream that contributes its water to another stream or body of water.
Water harvesting	The collection and concentration of runoff for productive purposes such as crops, fodder, pasture, trees, livestock and / or water supply. Water harvesting includes all methods of concentrating, diverting, collecting, storing, utilising and managing runoff for productive purposes.
Watershed	(1) A land area which is defined by the drainage of water towards a common watercourse in a natural basin. (2) The dividing line between two adjoining river systems
Watershed Approach	A framework for coordination and implementation of activities that addresses prioritised problems within hydrologically defined geographical areas
Watershed Management	Water resource protection, enhancement and restoration. Optimum watershed management sees the development of solutions that consider all of the problems facing a watershed, include all of its stakeholders in defining these problems, propose solutions, and involve all stakeholders in the implementation of these solutions
Water Spreading Weir (WSW)	A WSW spans the entire width of a valley to spread floodwater over the adjacent land area. Water encounters the weir and spreads off its side wings onto a larger surrounding area, including over the sides of the river bed. WSWs increase water infiltration into permeable soil and recharge groundwater. By detaining sediments they also foster the accumulation of breeding plants and natural biological protection measures.

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