Sustainable Land Management (SLM)

A compilation of SLM technologies and approaches for the Lowland Soil Rehabilitation Project in Ethiopia

2024

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Table of contents

List of acronyms

BMZ	Federal Ministry for Economic Cooperation and Development, Germany
CDE	Centre for Development and Environment
CIAT	International Centre for Tropical Agriculture
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
LSRP	Lowland Soil Rehabilitation Project
ProSoil	Global Programme "Soil Protection and Rehabilitation for Food Security"
SLM	Sustainable Land Management
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
WOCAT	World Overview of Conservation Approaches and Technologies

List of figures

Definitions

Sustainable land management (SLM) is the use of land resources, including soils, water, animals, and plants, to produce goods to meet changing human needs while ensuring the long-term productive potential of these resources and the maintenance of their environmental functions.

An SLM technology refers to a physical practice on the land that controls land degradation and enhances productivity and/or other ecosystem services. It consists of one or more measures, such as agronomic, vegetative, structure, and management measures.

An SLM approach defines the ways and means to implement one or more SLM technologies. It includes technical and material support as well as the involvement and roles of different stakeholders. It can refer to a project/programme or activities initiated by land users.

Source: WOCAT[1]

[1] WOCAT, "Glossary," *https://www.wocat.net/en/glossary/*.

Acknowledgments

We wish to acknowledge the invaluable contributions of all the farmers who are implementing sustainable land management (SLM) technologies and approaches, spreading knowledge of SLM, contributing to sustainable soil use and the rehabilitation of degraded soils.

The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), as a Consortium Partner of the World Overview of Conservation Approaches and Technologies (WOCAT), led this compilation and data collection. This data derives from the soil rehabilitation technologies and approaches implemented by the Global Programme "Soil Protection and Rehabilitation for Food Security" (ProSoil), implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. ProSoil is commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) as part of Germany's special iniative "Transformation of Agricultural and Food Systems". It is co-funded by the European Union and the Bill & Melinda Gates Foundation.

Under the coordination of Noel Templer, Gerba Leta collected data on the SLM practices. We thank the WOCAT team members Nicole Harari, Joana Eichenberger, and Rima Mekdaschi Studer and the GIZ team in Ethiopia for their invaluable contributions. We also acknowledge the diligent work of the technical editors and reviewers Torben Helbig, Noel Templer, William Critchley, and Rima Mekdaschi Studer.

Tabitha Nekesa developed this compilation under the technical leadership of Stephanie Jaquet. Maps were created by Zhanguo Bai from the International Soil Reference and Information Centre (ISRIC) and Beatrice Wanjiku from the Alliance of Bioversity International and CIAT; special thanks go to Sherry Adisa for her excellent infographics and layout.

About

Germany's Federal Ministry for Economic Cooperation and Development (BMZ) has significantly invested in sustainable land and soil management (hereafter, SLM) and climate change adaptation efforts, exploring co-benefits with carbon sequestration in Africa and India. The Global Programme "Soil Protection and Rehabilitation for Food Security" (ProSoil) is part of BMZ's special initiative "Transformation of Agricultural and Food Systems", implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, and a Consortium Partner of the World Overview of Conservation Approaches and Technologies (WOCAT). ProSoil supports smallholder farmers in Benin, Burkina Faso, Ethiopia, India, Kenya, Madagascar and Tunisia through training and capacity building in sustainable land management (SLM). The programme promotes the adoption of climate-smart, agroecological practices in its ProSoil partner countries to protect land from erosion and restore and maintain soil fertility. The programme collaborates with local governments, and public and private sectors in the advancement of sustainable food and agricultural systems. The European Union (EU) is co-funding the programme's work in the field of agroecology in Kenya, Ethiopia, Madagascar and Benin. Another co-funder is the Bill & Melinda Gates Foundation.

The World Overview of Conservation Approaches and Technologies (WOCAT – www.wocat.net) is a global network on SLM that promotes documenting, sharing, and using knowledge to support adaptation, innovation, and decision-making in SLM. WOCAT supports governments and their development partners in effectively using knowledge management and decision-support tools and processes to prevent and reduce land degradation and restore degraded land. Following this, WOCAT and its partners developed standardised questionnaires for assessing and documenting SLM practices. Such practices include both approaches and technologies. Questionnaire data are included in the Global SLM Database, the primary recommended database by the United Nations Convention to Combat Desertification (UNCCD) for reporting on SLM best practices.

The Alliance of Bioversity International and CIAT provide research-based solutions to global challenges of climate change, biodiversity loss, environmental degradation, and malnutrition. The organisation, a steering committee member of the WOCAT network, supported WOCAT's work on documentation, sharing, mainstreaming, and scaling out SLM practices in ProSoil project countries.


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Foreword

Agriculture is the cornerstone of Ethiopia's economy, and more than 80 per cent of the population lives in rural areas, depending on agricultural activities. Of this rural population, more than 18 million people live in arid lowland areas, seeking a livelihood as (agro-) pastoralists. These rural populations are severely affected by declining soil health and soil degradation.

In the Ethiopian lowlands, the declining soil health manifests itself in gully erosion, nutrient depletion, salinisation, acidification, and desiccation of entire valleys. The soil degradation is driven mainly by unsustainable land management practices, deforestation, overgrazing and extreme weather events such as flash floods and drought. For the (agro-) pastoralist population, this results in low agricultural productivity, nutrient depletion, and food insecurity.

Therefore, Ethiopia's efforts to safeguard soil health through Sustainable Land Management practices (SLM) are essential for ensuring food security, environmental sustainability, and the overall well-being of present and future generations. Sustainable Land Management (SLM) technologies are important tools to address soil degradation, promote agricultural sustainability and enhance soil health and resilience.

The Lowland Soil Rehabilitation Project (LSRP) is part of the Global Programme "Soil Protection and Rehabilitation for Food Security" and works to increase drought resilience in the Ethiopian lowlands through soil rehabilitation and productive use. Jointly with its regional and local government partners, the project has developed the Dry Valley Rehabilitation and Productive Use (DVRPU) approach, which is a holistic approach integrating social, technical, biological, economic, institutional and managerial measures to rehabilitate dry valleys for the benefit of the inhabitants and their livestock. The DVRPU approach is defined in seven crucial steps for sustainable rehabilitation of dry valleys:

1. Satellite identification and Dry valley delineation
2. Suitability assessment
3. Community participatory planning
4. Dry valley user cooperative (DVUC)
5. Technical and budgetary planning
6. Land rehabilitation measures
7. Productive use

Documented by the Alliance of Bioversity International and CIAT, this compilation consists of three SLM practices for rehabilitating dry valleys employed across Ethiopia. Technologies such as 'Water-spreading Weirs' and 'Masonry Check Dams' and approaches such as 'Participatory Rehabilitation of Dry Valleys' represent a response to the needs and conditions of Ethiopia's degraded landscapes. The practices have been published on the World Overview of Conservation Approaches and Technologies (WOCAT) global database to enhance adoption.

By documenting and disseminating these SLM technologies, this compilation aims to support the efforts of policymakers, practitioners, and communities working to safeguard Ethiopia's soil health and agricultural productivity. It is our hope that this resource will contribute to informed decision-making, foster knowledge exchange, and ultimately help build a more resilient and sustainable agricultural sector in Ethiopia.

Torben Helbig

Lowland Soil Rehabilitation Project (LSRP)

Advisor Climate Change, M&E and Gender

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Context

Over 18 million people in the lowlands of Ethiopia depend on pastoralism and agro-pastoralism for their livelihoods. However, land degradation is a major concern in the lowlands, threatening the environment and socio-economic development. Natural resources are under pressure due to rapid population growth and climate change, which leads to more frequent and severe droughts, erratic rainfall, and flash floods. The unfavorable climate conditions and poor management of agricultural resources further accelerate land degradation in the lowlands (Tesfay et al., 2022).

Anthropogenic causes	Natural causes
• Overgrazing	• Climate change
• Natural vegetation removal	• Low rainfall and arid conditions
• Land use changes	• Erratic rainfall
• Overpopulation	• Flash floods
• Poor soil and water management practices	• Soil erosion

Figure 1: Causes of land degradation in the lowlands of Ethiopia

Intensified human activities in the lowlands have significantly contributed to land degradation. Unsustainable, inappropriate land use has negatively impacted ecosystem services, affecting humans, animals, and the environment. The detrimental effects of these poor land use practices are most evident in the dry valleys of the lowlands, which are especially fragile. The Lowland Soil Rehabilitation Project (LSRP), as part of the ProSoil programme, promotes SLM practices in eight districts in the Afar region, one district in Oromia, and all districts in the Somali region of Ethiopia. By rehabilitating the soil, enhancing drought resilience, and encouraging productive use, SLM practices guarantee the long-term sustainability of food, livelihoods, and environmental systems. The project developed the Dry Valley Rehabilitation and Productive Use (DVRPU) approach in collaboration with regional and local government partners. This approach aims to rehabilitate dry valleys to benefit the local communities and their livestock by integrating technical, biological, economic, social, institutional, and managerial measures. The approach leverages existing political-administrative structures and traditional management systems to ensure sustainability. Implementation of SLM practices under the DVRPU approach considers seven crucial steps:

1. **Satellite identification**: Potential dry valleys are identified with the help of satellite or drone images. The images are then processed, and potential dry valleys are delineated.
2. **Suitability assessment**: The potential dry valley is checked for suitability by ground-truthing, examining land rights, land and natural resource management, the level of community organization, gender aspects, and community livelihood strategies.
3. **Community participatory planning:** The activity planning process engages the community from the outset and the respective governmental partners, including exchange visits to rehabilitated areas.
4. **Dry valley user cooperatives**: These are established by the communities living or regularly using the dry valley. They define by-laws for protecting, managing, and using the rehabilitated lands and their productive use.

5. **Technical and budgetary planning:** A detailed technical rehabilitation plan is developed with the community and partners including a standardised budget. The planning, closely monitored, spans a maximum of 10 years with detailed annual planning.

6. **Land rehabilitation measures:** Both physical and biological technologies and approaches are used. Physical measures include water-spreading weirs and dry-stone measures. Biological approaches enhance the protection of physical structures, such as area enclosures and the planting of hardy plants.

7. **Productive use:** The approach aims to use the rehabilitated area for productive use by introducing suitable fodder and food crops. One dry valley has the potential to create food security for 6000 people.

Methodology

The WOCAT documentation process was carried out in four main stages:

1. **Selection of practices for documentation.** The ProSoil project has disseminated SLM practices across the Afar, Oromia, and Somali regions. The three practices for documentation were selected based on their presence or absence in the WOCAT SLM database. The criteria considered whether the practice:
    - Responds to the country's priorities defined by the UNCCD PRAIS 4 report
    - Holds status as a priority for the government, GIZ, and ProSoil partners
    - Demonstrates adoption by farmers without external support

2. **Training on the questionnaire and validation of the practices to be documented.** A 3-day training course on WOCAT documentation organised by the Alliance-CIAT, the Centre for Development and Environment (CDE) of the University of Bern, Switzerland, in collaboration with the ProSoil by GIZ, was conducted in Adama. The workshop involved training on the WOCAT documentation framework and linkage to UNCCD best practices, training on the use of WOCAT questionnaires and database, and the selection of SLM practices implemented by ProSoil-Ethiopia and its partners for potential documentation on the WOCAT database.

3. **Data collection and addition to WOCAT's online Global SLM Database.** Data collection on SLM technologies and approaches was conducted through field visits in ProSoil project areas using WOCAT questionnaires. This task was carried out by a consultant in collaboration with the ProSoil team, SLM specialists, and farmers, with support from the Alliance-CIAT. The WOCAT questionnaire covers several modules, including general information on the SLM technology or approach, descriptions and classifications of SLM practices, technical specifications and implementation activities, inputs and costs, and the natural and human environment. Documentation of impacts, concluding statements, and references with accompanying links are included.

4. **Reviewing and publishing of SLM technologies and approaches.** ProSoil and the Alliance-CIAT teams undertook an initial review of the questionnaires. Technical editors, compilers, and the WOCAT secretariat conducted the final review for data completeness. After approval, the SLM technologies and approaches were published in WOCAT's global database.

SLM technology/approach documentation process

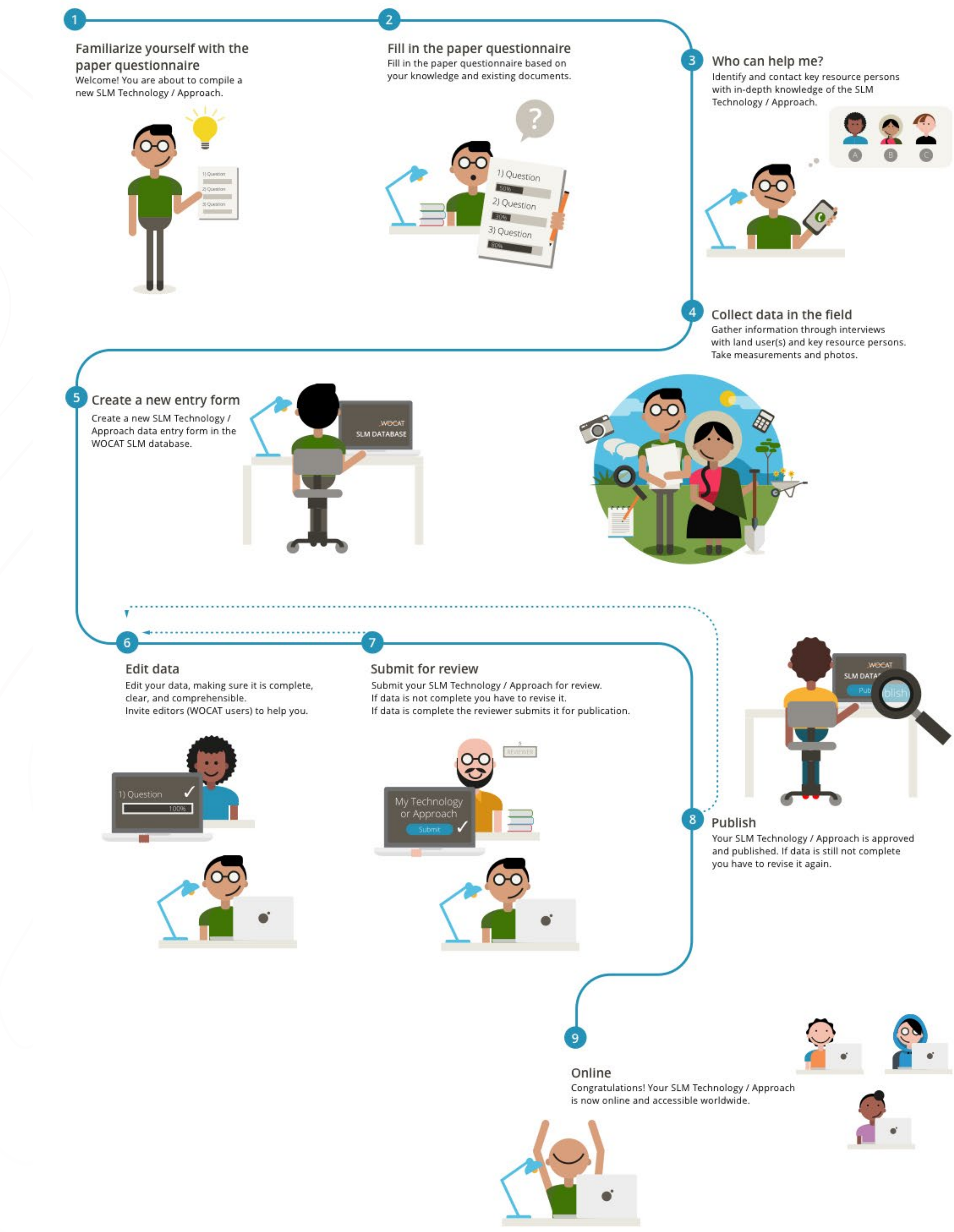


Figure 2: Steps of the WOCAT documentation process

Categories of SLM practices

Water and soil management and infrastructure

- SLM approach: Participatory rehabilitation of dry valleys
- SLM technology: Water-spreading weirs
- SLM technology: Double basin masonry check dam

Community consultation and participatory discussion. (Ahmednur Mohamed)

Participatory Rehabilitation of Dry Valleys (Ethiopia)

Kaqayb Galka Dadwayne

DESCRIPTION

Participatory rehabilitation and productive use of dry valleys is an approach employed to rehabilitate degraded and degradable land. It is operationalised through the Lowland Soil Rehabilitation Project with local development partners from kebele, district, regional agricultural bureaus, and other relevant stakeholders.

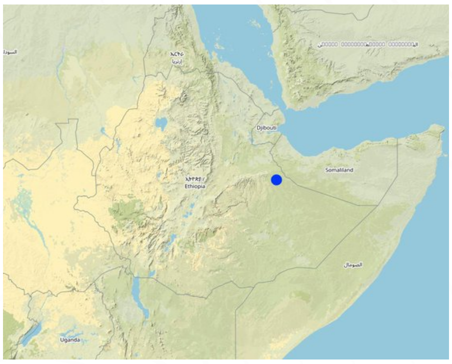
Participatory rehabilitation of degraded and degradable dry valleys engages the community at the grassroots through consultation. It is operationalised through the Lowland Soil Rehabilitation Project with local development partners from kebele, district, regional agricultural bureaus, and other relevant stakeholders. Technical experts from the district and region are involved in reconnaissance, observation and joint selection of the intervention sites. The team conduct a survey, then profile and design the technologies required, along with the project engineer. The approach optimises the participation of the community and agricultural actors, allowing the development of a sense of ownership and accountability through training and awareness-creation exercises. In turn this encourages them to take care of and maintain the structures.

This approach combines top-down and bottom-up methods. At the grassroots, the local agropastoral communities are mobilized by local extension agents and made aware about the SLM intervention that the project and partners strive to put in place – including the physical structures in the farmers' fields and communal lands. The procedures include a site visit, a survey/ observation, and the identification of the intervention site based on the specific topographic features and drainage system of the catchment. Then, detailed field data is collected and a profile analysis is made to develop the design and get approval after stakeholders' consultation and review of the details of the implementation design. The approach is complemented by satellite imagery and ground truthing. Following this, the next stage is identification of masonry experts, provision of training, and supply of construction materials and tools. Building the masonry works involves both skilled and unskilled labour.

The woreda NRM expert (focal person) facilitate the process at the grassroots through the development agents. The community gives their consent and support to the objectives of the project implementation. Therefore, they are involved in local decision-making and overseeing the technology that is being put in place.

The agropastoral community is the end user and benefits from the positive consequences of the intervention which is a result of better management of soil and water for productive uses of the dry valley. However, because of a lack of awareness, and the agropastoralists conventional livelihoods practice traveling with their livestock, there is a lack of participation in the day-to-day implementation activities. That limits their active contribution in implementation. Of course, local elders value the consultative experience which confirms a sense of self-worth and acknowledges their role in ownership of the land and as the ultimate decision-maker for development intervention operating in their areas.

LOCATION



Location: Amadle kebele, South Jijiga district, Somali, Ethiopia

Geo-reference of selected sites

- 42.99074, 9.26683

Initiation date: 2021

Year of termination: n.a.

Type of Approach

- [ ] traditional/ indigenous
- [ ] recent local initiative/ innovative
- [x] project/ programme based

Stakeholder discussion regarding the project implementation and follow-up actions. (Ahmednur Mohamed)

APPROACH AIMS AND ENABLING ENVIRONMENT

Main aims / objectives of the approach

To engage the community and other stakeholders in making participatory decisions on the rehabilitation of the dry valley.

Conditions enabling the implementation of the Technology/ ies applied under the Approach

- **Availability/ access to financial resources and services**: Access to finance promotes intensive awareness creation and participation of the community to implement the technology at a larger scale. Also, it allows supporting the maintenance and other follow on actions that ensure sustainability.
- **Institutional setting**: Setting up the local institution such as an agropastoralist group enables the effective implementation of dry valley rehabilitation technologies/practices.
- **Collaboration/ coordination of actors**: Coordination of actors enables the identification of useful actors and cross-fertilize experiential knowledge for documentation and further uses. Also, it enables acknowledgment of the contribution of different actors.
- **Knowledge about SLM, access to technical support**: Having SLM knowledge enables efficient and effective implementation of dry valley rehabilitation technologies.
- **Workload, availability of manpower**: Labour in the agropastoralist area is the limiting factor for the effective implementation of SLM practices. Therefore, the availability of labor or manpower is pivotal for the proper implementation of the SLM.

Conditions hindering the implementation of the Technology/ ies applied under the Approach

PARTICIPATION AND ROLES OF STAKEHOLDERS INVOLVED

Stakeholders involved in the Approach and their roles

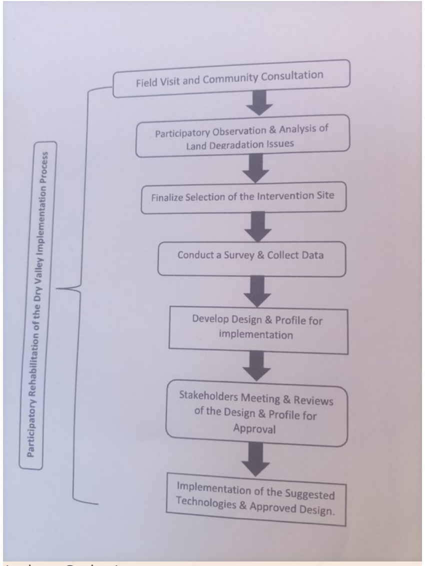
What stakeholders / implementing bodies were involved in the Approach?	Specify stakeholders	Describe roles of stakeholders
local land users/ local communities	Agropastoralist.	Participatory planning and decision making, sources casual laborer and oversee the technologies/practices.
SLM specialists/ agricultural advisers	Natural Resource Management experts.	Facilitate stakeholders' participation, provide technical support, and backstopping services, and monitor the development during and after the implementation of the technologies.
private sector	Contractor to perform the engineering works.	Building/constructing the physical structures.
GIZ project	GIZ (bilateral cooperation) projects.	Provide financial and technical support to the government partner organizations to promote the proper implementation of the rehabilitation of dry valley.

Involvement of local land users/ local communities in the different phases of the Approach

	none	passive	external support	interactive	self-mobilization	
initiation/ motivation				✓		Agropastoralists involve in allowing peers to understand SLM-related intervention.
planning				✓		Land users involve in participatory planning and decision-making exercise.
implementation			✓			Skilled and unskilled laborers are sources from neighboring urban areas and the intervention kebeles.
monitoring/ evaluation			✓			SLM experts and extension agents support in monitoring and evaluation of the intervention activities.

Flow chart

The sketch describe the process of implementing Participatory Rehabilitation of Dry Valleys.



Author: Gerba Leta

Decision-making on the selection of SLM Technology

Decisions were taken by

- [ ] land users alone (self-initiative)
- [ ] mainly land users, supported by SLM specialists
- [ ] all relevant actors, as part of a participatory approach
- [x] mainly SLM specialists, following consultation with land users
- [ ] SLM specialists alone
- [ ] politicians/ leaders

Decisions were made based on

- [x] evaluation of well-documented SLM knowledge (evidence-based decision-making)
- [ ] research findings
- [ ] personal experience and opinions (undocumented)

TECHNICAL SUPPORT, CAPACITY BUILDING, AND KNOWLEDGE MANAGEMENT

The following activities or services have been part of the approach

- [x] Capacity building/ training
- [x] Advisory service
- [x] Institution strengthening (organizational development)
- [x] Monitoring and evaluation
- [ ] Research

Capacity building/ training

Training was provided to the following stakeholders

- [ ] land users
- [x] field staff/ advisers

Form of training

- [x] on-the-job
- [ ] farmer-to-farmer
- [ ] demonstration areas
- [x] public meetings
- [ ] courses
- [x] Masonry workers

Subjects covered

Dry Land Rehabilitation and Produce Use of the rehabilitated land. Basically, the training is on the SLM practices which are suitable for agropastoralist areas with special emphasis on the physical structure.

Advisory service

Advisory service was provided

- [x] on land users' fields
- [ ] at permanent centres

Advisory services related to SLM are infrequently given. As the agropastoralists are mobile looking for feed and water, particularly during the dry period, advisory services have not been provided on regular basis.

Institution strengthening

Institutions have been strengthened / established

- [ ] no
- [x] yes, a little
- [ ] yes, moderately
- [ ] yes, greatly

at the following level

- [x] local
- [ ] regional
- [ ] national

Describe institution, roles and responsibilities, members, etc.
Stakeholders from government and bilateral organization (project) do make ad hoc meeting during planning and evaluation, this brings actors together but need to establish a sustainable institution that stands on its own and can be working beyond the project's lifetime. Particularly, a land users (agropastoralist) group is essential to oversee the technology placed on their land so that sustainability of the intervention can be ensured.

Type of support

- [x] financial
- [x] capacity building/ training
- [x] equipment

Further details
The equipment refers to the technical tools that can be used by the partner experts - but not farm tools. The latter is expected during which the agropastoralist resumes the productive use of the rehabilitated land which is currently in the initial years of implementation and not yet associated with the productive uses of it.

Monitoring and evaluation

The monitoring and evaluation are part of the project implementation that enables the implementers to track the development and engage the end users to enable them to sense the benefits. The land users started to benefit from the structure such as fetching drinking water both for human and their livestock, though, it is an indirect benefit from the intervention.

FINANCING AND EXTERNAL MATERIAL SUPPORT

Annual budget in USD for the SLM component

The following services or incentives have been provided to land users

- [ ] Financial/ material support provided to land users
- [ ] Subsidies for specific inputs

- [ ] < 2,000
- [x] 2,000-10,000
- [ ] 10,000-100,000
- [ ] 100,000-1,000,000
- [ ] > 1,000,000

Precise annual budget: n.a.

No specific data on budget allocation for SLM at the district level. However, Local Subsidy Contract (LSC) was used to assist the woreda implement and follow-up the development of the intervention.

- [ ] Credit
- [ ] Other incentives or instruments

IMPACT ANALYSIS AND CONCLUDING STATEMENTS

Impacts of the Approach

	No	Yes, little	Yes, moderately	Yes, greatly
Did the Approach empower local land users, improve stakeholder participation? Local land users consulted and informed regarding the benefits of SLM for the degraded and potentially degradable lands to ensure rehabilitation and its productive use. This may give motivation and a sense of self-worth as land owner.		✓		
Did the Approach enable evidence-based decision-making? Beyond the approach, the land users can learn from the actual function of the technologies.		✓		
Did the Approach help land users to implement and maintain SLM Technologies? Consultation with the land users motivates them to build trust in the intervention.		✓		
Did the Approach improve coordination and cost-effective implementation of SLM? In the long run, it can assist land users mobilize casual laborers.		✓		
Did the Approach mobilize/ improve access to financial resources for SLM implementation?	✓			
Did the Approach improve knowledge and capacities of land users to implement SLM? The approach creates an opportunity for land users to engage in the initial implementation process through which their awareness is raised.				✓
Did the Approach improve knowledge and capacities of other stakeholders? Through stakeholders meeting and training opportunities created by the project.			✓	
Did the Approach build/ strengthen institutions, collaboration between stakeholders? It builds collaboration between stakeholders.			✓	
Did the Approach mitigate conflicts?	✓			
Did the Approach empower socially and economically disadvantaged groups? Involve them in the awareness creation training.		✓		
Did the Approach improve gender equality and empower women and girls? Women are involved in the community meeting and/or consultation. Also benefited from the technology as it creates the opportunity to fetch drinking still water closer to their residence.		✓		
Did the Approach encourage young people/ the next generation of land users to engage in SLM? It provides knowledge to the young generation through exposure to evidence based intervention.		✓		
Did the Approach improve issues of land tenure/ user rights that hindered implementation of SLM Technologies?	✓			
Did the Approach lead to improved food security/ improved nutrition? The technology implemented using the participatory approach believed to rehabilitate degraded lands and enhances productive use of the rehabilitated lands for growing various crops, and supply feeds to the livestock.		✓		
Did the Approach improve access to markets?	✓			
Did the Approach lead to improved access to water and sanitation? The technology implemented using this approach creates land users temporal access to still as well as groundwater regardless.		✓		
Did the Approach lead to more sustainable use/ sources of energy?	✓			
Did the Approach improve the capacity of the land users to adapt to climate changes/ extremes and mitigate climate related disasters? In the future, when the productive use of dry valley is effected, post the rehabilitation efforts, land users certainly develop an adaptation to climate change and associated disasters through participatory approach.			✓	
Did the Approach lead to employment, income opportunities? It improves generation of income from the production of food and feed crops.		✓		

Main motivation of land users to implement SLM

- [x] increased production
- [x] increased profit(ability), improved cost-benefit-ratio
- [x] reduced land degradation
- [x] reduced risk of disasters
- [ ] reduced workload
- [ ] payments/ subsidies
- [ ] rules and regulations (fines)/ enforcement
- [ ] prestige, social pressure/ social cohesion
- [ ] affiliation to movement/ project/ group/ networks
- [ ] environmental consciousness
- [ ] customs and beliefs, morals
- [x] enhanced SLM knowledge and skills
- [ ] aesthetic improvement
- [ ] conflict mitigation

Sustainability of Approach activities

Can the land users sustain what hat been implemented through the Approach (without external support)?

- [ ] no
- [ ] yes
- [x] uncertain

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Creates stakeholders awareness on SLM, and productive use of rehabilitated dry valley.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Time and energy/labor demanding to integrate efforts of experts from different organizations. Nurture proper joint planning for collective action.

- Improves coordination between agricultural actors in line offices, and other stakeholders collective action.
- Enhances participatory decision making on the development and use of the rehabilitated lands.

Strengths: compiler's or other key resource person's view
- It creates evidence based lesson learning to replicate similar practices across the region.
- It improves SLM implementation capacity of the development partners (agricultural offices) and the land users at local level.
- It encourages the government respective department to allocate matching fund for SLM operationalized by development partners.

- Shortage of financial and material resources to put the structure in place. Find and generate sources of resources and promote efficient use of the available budget.
- Improper participation of stakeholders (dropout of experts) Enforce participation through adopting binding by-laws to all.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome
- Recurrent droughts displace the land users while looking for water and feed to their animals. Ensure representation to the community, and assess enabling environment that reduce temporal displacement of the land users.
- Relatively low participation of the land users in the conception and implementation of the approach as well as the technology intended to rehabilitate the dry valley. Promote land users participation through intensive capacity building and awareness creation by gender and various categories of the community.
- Lack of forming agro-pastoralist group who are believed to share knowledge, skills and labor for collective oversee and maintenance of the technology when damage is encountered. Promote the development of a local institution that allows not only for the use of the land but also to oversee the gaps, report the issues, and involve in participatory fixing activities.

REFERENCES

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William Critchley
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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/approaches/view/approaches_6718/

Linked SLM data
Technologies: Water Spreading Weirs https://qcat.wocat.net/en/wocat/technologies/view/technologies_6715/
Technologies: Double Basin Masonry Check Dam https://qcat.wocat.net/en/wocat/technologies/view/technologies_6716/

Documentation was faciliated by

Institution
- CIAT International Center for Tropical Agriculture (CIAT International Center for Tropical Agriculture) - Kenya

Project
- Soil protection and rehabilitation for food security (ProSo(i)l)

Key references
- Problems and landscape approach for ecological rehabilitation in the dry valleys of Southwest China. Dong, Y. & Liu, S. (Undated): https://www.researchgate.net/profile/Shiliang-Liu-5/publication/221354340_Problems_and_Landscape_Approach_for_Ecological_Rehabilitation_in_the_Dry_Valleys_of_Southwest_China/links/574129be08ae9ace84160bec/

Links to relevant information which is available online
- Supporting local planning and the importance of mapping: https://dream.vandermeijde.net/wp-content/uploads/2022/11/220620_planningandmapping_Roden.pdf

Water Spreading Weirs (WSW) having just arrested fresh sediment and water from upstream runoff in the Togslwro cascade of Amadle kebele, South Jijiga district. (Gerba Leta)

Water Spreading Weirs (Ethiopia)

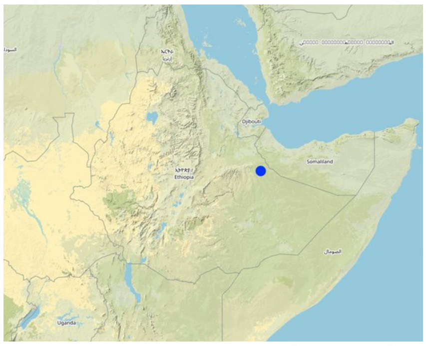
Biye Baahiwe

DESCRIPTION

Water Spreading Weirs are designed to protect the degradation of agricultural fields and rangelands. They contribute to soil and water conservation and enhance the productive use of dry valleys for food crops and livestock fodder production via the harvest and spread of runoff water and fertile soils.

Water Spreading Weirs (WSWs) spread runoff water to the tips of the structure's wings, slowing down the speed of runoff and arresting the sediment pouring downstream. WSWs are applicable both on farmland and rangelands to improve the productive use of the land's resources. They protect soil erosion and control gully development as well as increasing surface and sub-surface water availability. Activities such as mobilization of the community through awareness creation are among the numerous tasks implemented to put the technology in place. The community participates in site selection and participatory planning. Other stakeholders assist in area delineation, profiling the implementation area, and design. Labour and inputs such as surveying and construction materials, notably stone, sand, water, and cement, and equipment such as line levels, theodolites, spades, hoes, forks, string and measuring tapes etc. are required. On top of these, implementing the technology is supported by satellite images and ground validation exercises.
The main purpose of the technology is to reduce land degradation, harvest and use runoff water for spate irrigation and household uses, improve environmental resilience to the risks of drought, increase the depth and fertility of land behind the structure by capturing sediment washed away, allow infiltration of water and increase overall production of food and fodder crops. Also, the contribution to groundwater recharge is immense. Furthermore, it allows the agropastoral community to grow both cash and food crops which helps to ensure food security. Above all, the water harvested means people can remain in the area and that their livestock have access to drinking water for about three months after interception of rainfall. However, the agropastoralists may be discouraged by the size of the WSWs which can be from one hundred to over two hundred meters across. Care also must be taken that the structures do not cross livestock migration routes.

LOCATION



Location: Amadle kebele, South Jijiga district, Somali, Ethiopia

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 42.99074, 9.26683

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?: No

Date of implementation: 2022; less than 10 years ago (recently)

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [x] through projects/ external interventions

The sediment and water arrested by WSW right after the first shower. The rainwater is harvested and spread in the farm along the length of the structure. (Gerba Leta)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [x] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

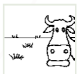
Land use

Land use mixed within the same land unit: Yes - Agro-pastoralism (incl. integrated crop-livestock)

Cropland

- Annual cropping: cereals - maize, cereals - sorghum, legumes and pulses - soya, vegetables - other
- Perennial (non-woody) cropping

Number of growing seasons per year: 1
Is intercropping practiced? Yes
Is crop rotation practiced? Yes



Grazing land

- Agro-pastoralist

Animal type: camels, cattle - dairy and beef (e.g. zebu), goats, sheep
Is integrated crop-livestock management practiced? Yes
Products and services: manure as fertilizer/ energy production, meat, milk, transport/ draught

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [x] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wm: mass movements/ landslides

soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition, Eo: offsite degradation effects

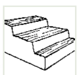
physical soil deterioration - Pi: soil sealing

water degradation - Ha: aridification, Hs: change in quantity of surface water, Hg: change in groundwater/aquifer level, Hp: decline of surface water quality, Hq: decline of groundwater quality

SLM group

- integrated crop-livestock management
- cross-slope measure
- irrigation management (incl. water supply, drainage)

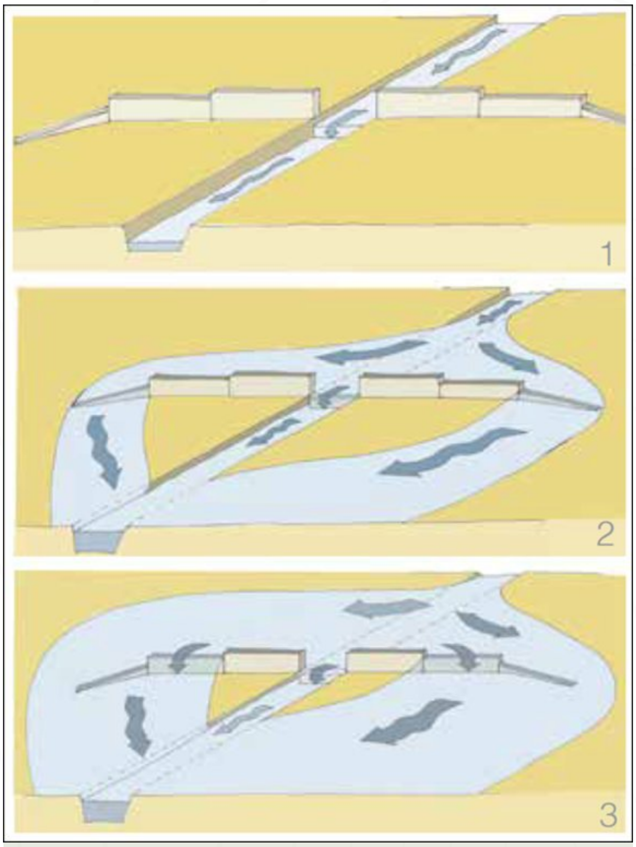
SLM measures



structural measures - S6: Walls, barriers, palisades, fences

TECHNICAL DRAWING

Technical specifications
Spate schemes depending on the increase supply flow:
Part i: The flow of small flood rested channel in the river bed
Part ii: A small or medium flood and overflows pours on the lower wings, &
Part iii: A large flood also pours on high wings.



Author: Anonymous consultant

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **1 WSW** volume, length: **Variable (could be from 100m to over 200m depending on the steepness and width of the farmland.**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 8.414 USD

Most important factors affecting the costs
Economic crisis and frequently escalating material costs along with rising financial inflation.

Establishment activities
1. Assessing the field (observation) (Timing/ frequency: None)
2. Consult the local community along with agricultural partners at different levels (Timing/ frequency: None)
3. Surveying and profile data collection (Timing/ frequency: None)
4. Develop design and get approval (Timing/ frequency: None)
5. Outsource the engineering/masonry works (Timing/ frequency: None)
6. Train the masonry workers (Timing/ frequency: None)
7. Supply materials (Timing/ frequency: None)
8. Implement (execute the excavation and the masonry work) (Timing/ frequency: None)
9. Monitor the development (construction supervision) (Timing/ frequency: None)

Total establishment costs (estimation)
27490.0

Maintenance activities
1. Assess and identify the damage (Timing/ frequency: During the off-season for ease of access to the sites)
2. Estimate the level and cost of damage (Timing/ frequency: During the off-season)
3. Supply materials (Timing/ frequency: None)
4. Employ the masonry worker (Timing/ frequency: None)
5. Construct /maintain the damaged parts (Timing/ frequency: Before the short/long rainy season.)

Total maintenance costs (estimation)
12154.0

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [x] 251-500 mm
- [ ] 501-750 mm

Agro-climatic zone
- [ ] humid
- [ ] sub-humid
- [x] semi-arid

Specifications on climate
Average annual rainfall in mm: 750.0
Rainfall is erratic and erosive. The project site receives rainfall twice a year (Belg- short rain from March to April and Meher- long rain from

- ☐ 751-1,000 mm
- ☐ 1,001-1,500 mm
- ☐ 1,501-2,000 mm
- ☐ 2,001-3,000 mm
- ☐ 3,001-4,000 mm
- ☐ > 4,000 mm

- ☐ arid

June to September). However, the number of days on which rain is intercepted is fewer than the ranges stated over here.
Name of the meteorological station: Jijiga Meteorology station
South Jigjiga district is characterized by hot weather.

Slope
- ☑ flat (0-2%)
- ☑ gentle (3-5%)
- ☐ moderate (6-10%)
- ☐ rolling (11-15%)
- ☐ hilly (16-30%)
- ☐ steep (31-60%)
- ☐ very steep (>60%)

Landforms
- ☑ plateau/plains
- ☐ ridges
- ☐ mountain slopes
- ☐ hill slopes
- ☐ footslopes
- ☐ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☐ 101-500 m a.s.l.
- ☐ 501-1,000 m a.s.l.
- ☐ 1,001-1,500 m a.s.l.
- ☑ 1,501-2,000 m a.s.l.
- ☐ 2,001-2,500 m a.s.l.
- ☐ 2,501-3,000 m a.s.l.
- ☐ 3,001-4,000 m a.s.l.
- ☐ > 4,000 m a.s.l.

Technology is applied in
- ☐ convex situations
- ☑ concave situations
- ☐ not relevant

Soil depth
- ☐ very shallow (0-20 cm)
- ☐ shallow (21-50 cm)
- ☑ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☐ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Topsoil organic matter content
- ☐ high (>3%)
- ☐ medium (1-3%)
- ☑ low (<1%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☐ 5-50 m
- ☑ > 50 m

Availability of surface water
- ☐ excess
- ☐ good
- ☐ medium
- ☑ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☑ poor drinking water (treatment required)
- ☐ for agricultural use only (irrigation)
- ☐ unusable

Water quality refers to: ground water

Is salinity a problem?
- ☑ Yes
- ☐ No

Occurrence of flooding
- ☑ Yes
- ☐ No

Species diversity
- ☐ high
- ☐ medium
- ☑ low

Habitat diversity
- ☐ high
- ☐ medium
- ☑ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ☑ subsistence (self-supply)
- ☐ mixed (subsistence/ commercial)
- ☐ commercial/ market

Off-farm income
- ☑ less than 10% of all income
- ☐ 10-50% of all income
- ☐ > 50% of all income

Relative level of wealth
- ☐ very poor
- ☑ poor
- ☐ average
- ☐ rich
- ☐ very rich

Level of mechanization
- ☑ manual work
- ☑ animal traction
- ☐ mechanized/ motorized

Sedentary or nomadic
- ☐ Sedentary
- ☑ Semi-nomadic
- ☐ Nomadic

Individuals or groups
- ☑ individual/ household
- ☐ groups/ community
- ☐ cooperative
- ☐ employee (company, government)

Gender
- ☐ women
- ☐ men

Age
- ☐ children
- ☐ youth
- ☐ middle-aged
- ☐ elderly

Area used per household
- ☐ < 0.5 ha
- ☐ 0.5-1 ha
- ☐ 1-2 ha
- ☑ 2-5 ha
- ☐ 5-15 ha
- ☐ 15-50 ha
- ☐ 50-100 ha
- ☐ 100-500 ha
- ☐ 500-1,000 ha
- ☐ 1,000-10,000 ha
- ☐ > 10,000 ha

Scale
- ☑ small-scale
- ☐ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☑ communal/ village
- ☐ group
- ☑ individual, not titled
- ☐ individual, titled

Land use rights
- ☐ open access (unorganized)
- ☑ communal (organized)
- ☐ leased
- ☑ individual

Water use rights
- ☐ open access (unorganized)
- ☑ communal (organized)
- ☐ leased
- ☑ individual

Access to services and infrastructure

health	poor		✓	good
education	poor		✓	good
technical assistance	poor		✓	good
employment (e.g. off-farm)	poor	✓		good
markets	poor		✓	good
energy	poor	✓		good
roads and transport	poor			✓ good
drinking water and sanitation	poor	✓		good

financial services — poor / good

IMPACTS

Socio-economic impacts

Crop production	decreased / increased	It is the expert's conviction that crop production in the area increased with water harvest and spread over the farm for use as spate or supplementary irrigation to the seasonal rainfall.
crop quality	decreased / increased	As the moisture harvested by the structure is believed to add grain filling period, the crop quality is also expected to increase.
fodder production	decreased / increased	Fodder production also increases with the availability of good soil and moisture conserved in the farm behind the structure.
fodder quality	decreased / increased	
animal production	decreased / increased	Increases with increasing availability of feed or fodder from either crop residue, natural grass or browse.
wood production	decreased / increased	
risk of production failure	increased / decreased	It rather improves crop resilience because of improved soil moisture.
product diversity	decreased / increased	
production area (new land under cultivation/ use)	decreased / increased	Opportunities can be created to increase the size of land under farming with increasing availability of moisture and fertile soils.
land management	hindered / simplified	Moisture availability eases the management operation.
energy generation (e.g. hydro, bio)	decreased / increased	
drinking water availability	decreased / increased	
drinking water quality	decreased / increased	Basically, quality is not a priority issue for agro pastoralists in dry valley areas.
water availability for livestock	decreased / increased	
water quality for livestock	decreased / increased	
irrigation water availability	decreased / increased	
irrigation water quality	decreased / increased	
demand for irrigation water	increased / decreased	
expenses on agricultural inputs	increased / decreased	As the structure reduces the degree of degradation, expense on agricultural inputs is believed to be reduced.
farm income	decreased / increased	
diversity of income sources	decreased / increased	
workload	increased / decreased	

Socio-cultural impacts

food security/ self-sufficiency	reduced / improved	
health situation	worsened / improved	
land use/ water rights	worsened / improved	
cultural opportunities (eg spiritual, aesthetic, others)	reduced / improved	
recreational opportunities	reduced / improved	
community institutions	weakened / strengthened	
national institutions	weakened / strengthened	
SLM/ land degradation knowledge	reduced / improved	It promotes land users' understanding of SLM through training and exposure to the actual structure and soil and water harvested behind the structure.
conflict mitigation	worsened / improved	
situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)	worsened / improved	They may manage to access water for livestock drink and/or household consumption.

Ecological impacts

water quantity	decreased / increased	

water quality	decreased					✓			increased	
harvesting/ collection of water (runoff, dew, snow, etc)	reduced					✓			improved	
surface runoff	increased						✓		decreased	
excess water drainage	reduced						✓		improved	
groundwater table/ aquifer	lowered						✓		recharge	
evaporation	increased				✓				decreased	
soil moisture	decreased						✓		increased	The structure harvests soil moisture on the farm. It reduces the speed of runoff, stops, and spread over the farm.
soil cover	reduced					✓			improved	Increased through production of more biomass.
soil loss	increased						✓		decreased	The physical barriers stops the soil and water loss.
soil accumulation	decreased							✓	increased	
soil crusting/ sealing	increased				✓				reduced	
soil compaction	increased				✓				reduced	
nutrient cycling/ recharge	decreased					✓			increased	
salinity	increased					✓			decreased	It is related to a warm climate that triggers evaporation and salinity development in the long run.
soil organic matter/ below ground C	decreased					✓			increased	
acidity	increased				✓				reduced	
vegetation cover	decreased					✓			increased	
biomass/ above ground C	decreased					✓			increased	
plant diversity	decreased					✓			increased	
invasive alien species	increased				✓				reduced	
animal diversity	decreased				✓				increased	
beneficial species (predators, earthworms, pollinators)	decreased					✓			increased	
habitat diversity	decreased					✓			increased	
pest/ disease control	decreased				✓				increased	
flood impacts	increased						✓		decreased	
landslides/ debris flows	increased					✓			decreased	
drought impacts	increased					✓			decreased	
impacts of cyclones, rain storms	increased				✓				decreased	
emission of carbon and greenhouse gases	increased					✓			decreased	
wind velocity	increased					✓			decreased	
micro-climate	worsened					✓			improved	

Off-site impacts

water availability (groundwater, springs)	decreased					✓			increased	As the structure is recently constructed, it is dire to envisage the off-site impacts of the technology at this juncture. However, it has a positive contribution to the availability of groundwater in the adjacent farms.
reliable and stable stream flows in dry season (incl. low flows)	reduced				✓				increased	Streams are less common in the dry valley.
downstream flooding (undesired)	increased						✓		reduced	It reduces the speed and volume of downstream flooding.
downstream siltation	increased						✓		decreased	
groundwater/ river pollution	increased				✓				reduced	Need an investigation of its impact on the groundwater.
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced					✓			improved	
wind transported sediments	increased					✓			reduced	
damage on neighbours' fields	increased					✓			reduced	
damage on public/ private infrastructure	increased				✓				reduced	
impact of greenhouse gases	increased					✓			reduced	Believed to reduce it in the long run.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative						✓		very positive
Long-term returns	very negative							✓	very positive

Benefits compared with maintenance costs

Short-term returns	very negative						✓		very positive
Long-term returns	very negative							✓	very positive

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all			✓			very well
annual rainfall decrease	not well at all				✓		very well

Climate-related extremes (disasters)

local rainstorm	not well at all			✓			very well
local sandstorm/ duststorm	not well at all		✓				very well
drought	not well at all			✓			very well
flash flood	not well at all			✓			very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The technology/structure reduce soil and water erosion.
- Harvest water and make the people and livestock beneficiaries from the still water for crop production, drinking, and household uses.
- Increase soil moisture and risks of crop failure because of shortage of rainfall.

Strengths: compiler's or other key resource person's view

- Rehabilitate both degraded agricultural and grazing lands.
- Improve agropastoralist access to livestock feed and benefit from the positive impact caused by the technology.
- Eventually, contributes to the improvement of ecology and overall ecosystem functioning.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- High initial investment cost. Enhance the in-kind contribution of the land users, and increase matching funds from the government as cost-sharing with other projects.
- Agropastoralist complains about the space it occupies in their farmland regardless of the benefit they accrue over a long period. Increase the awareness of the community on the productive uses of the degrading land based on the evidence.
- The structure may fall over the livestock migration/travel routes that are not acknowledged by some members of the community. During masonry work, precaution is essential to calm down the possible complaints that could emerge because of the raised structure by leveling the crossover roads/paths.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- An inadequate number of structures in a cascade subjected to ineffective soil and water management and distribution of rainwater to support as supplementary sources of moisture for crop production. Increase the number of structures per conceptual statement and standardize the intervals between the structures.
- Excessive land users' desire that is unassociated with a tangible contribution to the development of the technology from their side. Further building land users understanding of SLM technologies and their benefits so that they can build a sense of ownership and accountability to contribute and complement the external efforts.
- Land users give emphasis mainly on the immediate benefits of the technology (harvesting water for livestock drinking and household use) than the objectives of rehabilitating the dry valley for productive use of it such as crop and livestock feed production. Acknowledging the immediate benefits, and the mainstreaming work regarding the pillar objectives of the project intervention.
- The initial investment, as well as maintenance costs, are either expensive or overestimated by local actors. Such a higher cost may discourage land users in the absence of projects or SLM funds. It would be good to be pragmatic in cost estimation. Furthermore, adapting the technology using local materials may promote the adoption and sustainability of the structure for widespread use.

REFERENCES

Compiler
GERBA LETA

Editors
Torben Helbig
Noel Templer

Reviewer
William Critchley
Rima Mekdaschi Studer

Date of documentation: March 21, 2023

Last update: April 27, 2023

Resource persons
Badal Mohamed - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_6715/

Linked SLM data
Approaches: Participatory Rehabilitation of Dry Valleys https://qcat.wocat.net/en/wocat/approaches/view/approaches_6718/

Documentation was faciliated by

Institution
- CIAT International Center for Tropical Agriculture (CIAT International Center for Tropical Agriculture) - Kenya

Project
- Soil protection and rehabilitation for food security (ProSo(i)l)

Key references
- Mekdaschi & Linger, 2013. Freie Universitat Berlin: https://www.geo.fu-berlin.de/en/v/iwrm/Introduction/Principles/index.html

Links to relevant information which is available online
- Water-spreading weirs: https://www.unccd.int/best-practice/water-spreading-weirs
- Water Spreading Weir - NATURAL RESOURCE MANAGEMENT: https://nrmdblog.wordpress.com/2016/12/12/water-spreading-weir/

Double basin Masonry Check Dam where massive amounts of sediment are trapped by the structure (Gerba Leta)

Double Basin Masonry Check Dam (Ethiopia)

NA

DESCRIPTION

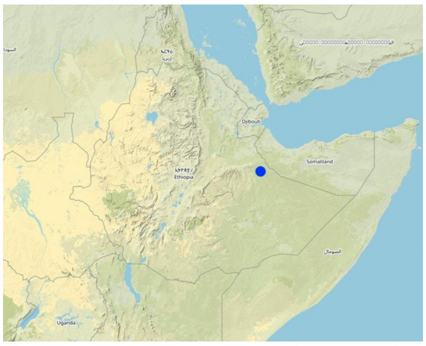
A double basin masonry check dam is a physical structure that helps to stop gully formation or further development of gullies in dry valleys. It rehabilitates small to a medium-sized deep gullies that are eating into the heart of adjacent land.

A "double basin masonry check dam" is a structure built in a narrow gully or depression to stop further gully formation. It is made of stone, concrete, gabions and wooden bars and serves as a permanent barrier. In this particular site stone is used as the structure is masonry. The technology is applied in areas where there are concentrated flows of water or runoff. The double basin masonry check dam is sited across a slope or a deep gully to slow water flow and capture sediment from upstream in the basins and behind the structure, thereby preventing expansion of the gully. The width of a check dam is variable. This particular structure is 14 meter wide, three meters deep and about 52 meters long. By helping to fill up the gully with sediment, it leads to rehabilitation and makes productive use of the area for growing trees, forage, and other plants. Apart from reducing the speed of surface runoff, the structure also promotes water infiltration, and recharges the groundwater reserves in the aquifer.

The main inputs necessary to build the check dams are financial resources, technical skills, skilled and unskilled labour, and construction materials including sand, stone, cement, water and other materials. Furthermore, construction tools such as a theodolite, line level, string, hammers, spades, hoes, and other tools are essential for design & construction. Technical skills for designing and profiling, and further capacity-building training are essential also. Application of the technology is also supported by satellite image and ground truthing to ensure the precision of siting.

The agropastoralists in the dry basin areas are pleased to see a huge movement of the soil arrested by the structure. The reduced expansion of the gully into the heart of the farm and grazing lands raises hopes of their land become productive and remaining so for generations to come. This hope and expectation have motivated them to welcome the intervention and develop an understanding of the actual benefits accrued from it. This leads to their support for the construction efforts. The disadvantages are that the technology is labour and resource-intensive which can be unaffordable for resource-poor agropastoralist communities living in food-insecure areas where rainfall is unreliable. This may make the adoption of the technology difficult to establish and nurture on their own without outside support.

LOCATION



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- [ ] during experiments/ research
- [x] through projects/ external interventions

Massive sediments and debris trapped behind the recently built structure. (Gerba Leta)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [ ] improve production
- [x] reduce, prevent, restore land degradation
- [x] conserve ecosystem
- [x] protect a watershed/ downstream areas – in combination with other Technologies
- [x] preserve/ improve biodiversity
- [x] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

Land use

Land use mixed within the same land unit: No

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [x] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

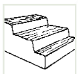
Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wm: mass movements/ landslides

SLM group

- pastoralism and grazing land management
- cross-slope measure
- water harvesting

SLM measures

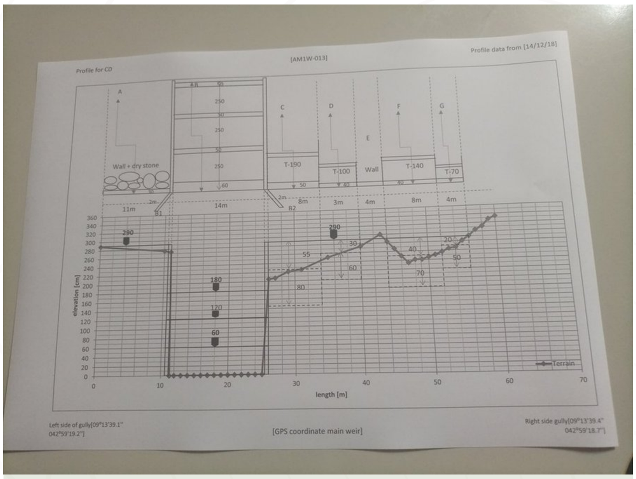


structural measures - S6: Walls, barriers, palisades, fences

TECHNICAL DRAWING

Technical specifications

The design (layout - top view) and profile (lower view) of the technology is presented with universal units to clearly read and understand by the SLM experts or engineers. In addition, there are section drawings of the main weir and Bill of Quantity (BOQ).



Author: Amir Abdi

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **check dam** volume, length: **14m*3m*52m =2184m3**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 8.5 - 16 USD based on their skills

Most important factors affecting the costs

Inflation and increasingly changing material prices, labor and transportation costs.

Establishment activities

1. Conduct rapid assessment and Surveillance of intervention site (Timing/ frequency: During the off-season)
2. Finalize site selection (Timing/ frequency: ditto)
3. Layout, Design and profiling works (Timing/ frequency: None)
4. Identify and train masonry workers (Timing/ frequency: During off-season)
5. Material supply (Timing/ frequency: None)
6. Start actual layout and excavation work (Timing/ frequency: None)
7. Supervision... (Timing/ frequency: None)

Total establishment costs (estimation)

9200.0

Maintenance activities

1. Oversee and identify damage (Timing/ frequency: During and after rainy season)
2. Measure the degrees of damage (Timing/ frequency: ditto)
3. Quantify cost and materials needed (Timing/ frequency: None)
4. Schedule the maintenance work (Timing/ frequency: Right before the off-season)
5. Employ the workers and reconstruct the damaged parts or upgrade it. (Timing/ frequency: During off-season)

Total maintenance costs (estimation)

3244.0

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [x] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone

- [ ] humid
- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Specifications on climate

Rainfall distribution is erratic and erosive.
Name of the meteorological station: Jijiga Meteorology station
There are bimodal rainfall patterns but the distribution in each respective season is not uniform. Particularly, the past consecutive seasons have been characterized by drought.

Slope

- [ ] flat (0-2%)
- [x] gentle (3-5%)
- [x] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms

- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude

- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [x] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in

- [ ] convex situations
- [x] concave situations
- [ ] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [x] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [ ] 5-50 m
- [x] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [x] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: ground water

Is salinity a problem?
- [x] Yes
- [ ] No

Occurrence of flooding
- [x] Yes
- [ ] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [x] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [x] poor
- [ ] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [x] animal traction
- [ ] mechanized/ motorized

Sedentary or nomadic
- [ ] Sedentary
- [x] Semi-nomadic
- [ ] Nomadic
- [x] Agro-pastoralist

Individuals or groups
- [ ] individual/ household
- [x] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [ ] youth
- [ ] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [ ] state
- [ ] company
- [x] communal/ village
- [ ] group
- [x] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [x] individual

Access to services and infrastructure

	poor			good
health	poor	✓		good
education	poor	✓		good
technical assistance	poor	✓		good
employment (e.g. off-farm)	poor	✓		good
markets	poor		✓	good
energy	poor	✓		good
roads and transport	poor			✓ good
drinking water and sanitation	poor	✓		good
financial services	poor	✓		good

Comments

Not much service is available in the pastoralist area except that the road paths through the area also create access to the market and other service centers.

IMPACTS

Socio-economic impacts

fodder production

decreased ☐ ☐ ☐ ☐ ✓ ☐ ☐ increased

With the development of the sediments trapped by the structure by fodder crops of multipurpose tree species, it is possible to boost production and ensure the sustainability of the structure.

fodder quality

decreased ☐ ☐ ☐ ☐ ✓ ☐ ☐ increased

As the sediment brings in fertile topsoil from the upstream catchments, the likelihood of producing quality fodder in the rehabilitated area is so high.

wood production

decreased ☐ ☐ ☐ ☐ ✓ ☐ ☐ increased

The multipurpose tree species assumed to be planted in

Impact										Comment
										the rehabilitated area are expected to increase wood production.
drinking water availability	decreased					✓			increased	As the rehabilitated valley reduces runoff and increases the groundwater reserves, it caters to the opportunity to access drinking water.
drinking water quality	decreased					✓			increased	Succeeding vegetation covers enables to filter of the water and improves the quality of surface and subsurface water.
water availability for livestock	decreased					✓			increased	Slightly increases as the structure and rehabilitated areas improves water infiltration and formation of still water or micro ponds behind the structure.
water quality for livestock	decreased					✓			increased	Simultaneously increases with the availability of surface and subsurface water.

Socio-cultural impacts

Impact										Comment
food security/ self-sufficiency	reduced					✓			improved	Reduction of gully formations that consume the rangeland allows accessing relatively more rangeland areas for the livestock to graze over. This inevitably improves the food security of the pastoralist community.
SLM/ land degradation knowledge	reduced						✓		improved	The technology and its function along the mainstreaming work with local development actors certainly improve the understanding and evidence-based knowledge of the land users.

Ecological impacts

Impact										Comment
water quantity	decreased					✓			increased	The technology is believed to increase both surface and groundwater quantity in the intervention valley.
water quality	decreased					✓			increased	
surface runoff	increased						✓		decreased	Surface runoff speed and volume are gradually decreased with the rehabilitation of the gully and the development of the area behind the structure.
excess water drainage	reduced						✓		improved	
groundwater table/ aquifer	lowered					✓			recharge	
soil moisture	decreased						✓		increased	Soil moisture in the rehabilitated area positively increased.
soil cover	reduced					✓			improved	
soil loss	increased						✓		decreased	As the structure on the upstream side reduces the speed of runoff, soil, and water loss decrease, and soil accumulation is increasing over time.
soil accumulation	decreased						✓		increased	
soil crusting/ sealing	increased				✓				reduced	
vegetation cover	decreased					✓			increased	It increases with the deposition of sediments. Seeds of different trees and vegetation can emerge as succession species.
plant diversity	decreased					✓			increased	Increases!
flood impacts	increased						✓		decreased	The structure and rehabilitated areas reduces the speed and impacts of the flood.
landslides/ debris flows	increased					✓			decreased	
drought impacts	increased					✓			decreased	
emission of carbon and greenhouse gases	increased					✓			decreased	Overtime, tree cover reduces emission of carbon and green gases.

Off-site impacts

Impact										Comment
water availability (groundwater, springs)	decreased					✓			increased	As the technology put in place in recent times, off-site

downstream flooding (undesired)	increased ✓ reduced		The structure and rehabilitated areas inevitably reduces downstream flooding and siltation in the future.
downstream siltation	increased ✓ decreased		There is visible siltation held back by the structure. However, quantifying demands empirical analysis.
groundwater/ river pollution	increased ✓ reduced		
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced ✓ improved		
damage on neighbours' fields	increased ✓ reduced		
damage on public/ private infrastructure	increased ✓ reduced		
impact of greenhouse gases	increased ✓ reduced		

impacts need assessment based on facts.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (6 of 7)	very positive
Long-term returns	very negative	✓ (7 of 7)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (6 of 7)	very positive
Long-term returns	very negative	✓ (7 of 7)	very positive

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	✓ (3 of 5)	very well
annual rainfall decrease	not well at all	✓ (3 of 5)	very well

Climate-related extremes (disasters)

general (river) flood	not well at all		very well	Answer: not known
flash flood	not well at all	✓ (5 of 5)	very well	
landslide	not well at all	✓ (4 of 5)	very well	

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Number of households and/ or area covered

Adoption rate is yet to be evaluated. The technology put in communal land.

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Rehabilitate the gully, and stop and reverse the gully formation.
- It creates the opportunity for productive use of the degraded environment.
- Recharge the groundwater aquifer and supply still water for temporary use by local people and livestock.

Strengths: compiler's or other key resource person's view

- Promote regeneration of the lost species through resilience building.
- Improve the landscape feature.
- Improve the ecosystem and its overall services.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- High investment cost to implement the technology. Promote government awareness and emphasis on the benefit and investment in developing the technology.
- Lack of implementation skills. Develop the skills and motivation of the community and other stakeholders.
- Conflict of interest on the use of the rehabilitated land in the intersection of neighboring kebeles. Awareness creation and promote behavioral change on the joint benefit of the technology.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- Inability to put micro check dams along the drainage line before it cuts deep into the soil. Improve surveillance and promote early intervention.

- Lower level of participation from the land users. Develop the capacity, awareness and motivation of the land users.
- Stakeholders and land users lower level of environmental education, improper land management and the consequent climate change and other associated adversities. Promote environmental education, emerging climate change and climate variability in adult and vocational education.

REFERENCES

Compiler
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Reviewer
William Critchley
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Resource persons
Amir Abdi - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_6716/

Linked SLM data
Approaches: Participatory Rehabilitation of Dry Valleys https://qcat.wocat.net/en/wocat/approaches/view/approaches_6718/

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Project
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Key references
- Criteria for optimizing check dam location and maintenance requirements. Hassanli, A. M. & Beecham. 2013; ISBN: 971-1-60876-146-3: https://www.researchgate.net/publication/287636490_Criteria_for_optimizing_check_dam_location_and_maintenance_requirements

Links to relevant information which is available online
- Different Types of Check Dams & Design Procedures: https://forestrybloq.com/different-types-of-check-dams/

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WOCAT
World Overview of Conservation Approaches and Technologies

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