Catalogue of Sustainable Land Management and Climate Smart Agriculture Practices in Ethiopia

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Overview

Massive SLM/CSA practices have been implemented for the last four decades in various agro-ecologies of Ethiopia. Nevertheless, these practices were not well catalogued in illustrative (pictorial) representation. Cataloguing Sustainable Land management (SLM) and Climate Smart Agriculture (CSA) practices, technologies and approaches is important in helping us to understand what we have, where they are located and what stories they tell. The first attempt is thus being made to catalogue and document the major SLM and CSA practices, technologies and approaches in Ethiopia with illustration of the practices as much as possible. The catalogue can be considered a live document which is open for revision based on the availability of new and additional information. In addition the content and style of the catalogue can be improved with input from SLM and CSA experts in the country and beyond.

The catalogue is developed by experts drawn from various institutions including The Bioversity International and CIAT (ABC), the Ministry of Agriculture (MoA) and the Ethiopian Institute of Agricultural Research (EIAR). Information was obtained from individual researchers who have amassed huge experience over long period of time. Photo galleries were acquired from different projects such as SLMP, RLLP/CSA and PSNP through project leaders and focal persons in various regions. Once the draft was prepared by these experts, the catalogue was verified and validated by experts from regions including Amhara, Benishangul Gumuz, Gambella, Oromia, Sidama, SNNP and Southwestern Ethiopia. The validation was done during the CSA training whorkshop which was held in November 20 to 25, 2022 at Adama, Ethiopia.

The catalogue provides a short description of practices including issue to be addressed, scale of implementation, agro-ecological zones, suitable land use and limitations. Most of the illustrations used were collated from successful cases to create awareness, facilitate adoption and support the notion 'seeing believing'. Generally, the catalogue contained about 70 practices under four categories; physical, biological, agronomic, water management and mixed (other) practices. The catalogue can serve stakeholders including researchers, development agencies and academia test, validate, implement and adopt in their localities.

Acknowledgement

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Background

Since the beginning of 1980's, the Government of Ethiopia (GoE) in collaboration with various partners has made a huge investment in sustainable land management practices in response to severe land degradation phenomena (Berhe, 1996). At the earlier time, the focus was on physical soil and water conservation practices in drought-prone areas using a food-for-work (FFW) approach, mainly funded by the World Bank (WB), World Food Programme (WFP) and the Food and Agriculture Organization of the United Nations (FAO) (Holden et al. 2001; Rahmato, 2001; Beshah 2003; Betru et al., 2015). The food-for-work approach evolved to various projects/programmes including MERET (Managing Environmental Resources to Enable Transition), Sustainable Land Management Project (SLMP I and II), Resilience Landscapes and Livelihoods Project (RLLP) and Climate Smart Agriculture (CSA). Under these various projects and programs, several practices/technologies/approaches have been implemented in various parts of the country. Nevertheless, these practices/technologies/approaches are not well catalogued. Although WOCAT attempted to catalogue SLM practices from various countries, only few and very limited practices/technologies/approaches related to Ethiopia are documented (https://www.wocat.net/en/).

Hence, the objective of this work is to catalogue and document the available SLM/CSA practices in Ethiopia and provide a robust database. The catalogue contains technologies/practices/approaches that can be implemented in various agroecologies (Hurni et al., 2016) under sustainable land management and/or climate smart agriculture (CSA) programs/projects/initiatives in Ethiopia. Most of the technologies/practices/approaches can also be scaled to other areas directly and/or with fine-tuning.

Physical SLM/CSA practices/technologies/approaches

1. Bench Terrace

Short description: A bench terrace is a conservation structure where a slope is converted into a series of steps, with a horizontal cultivated area on the step and steep risers between two steps. In Ethiopia, a bench terrace is usually developed from bunds and Fanya Juus over a period of 5–15 years through careful maintenance and build-up. In areas where stone are available, stone wall bench terrace are also constructed

Environmental/climate risk to be addressed: control soil erosion, conserve moisture, and improve soil fertility,

Scale to be used: Bench terrace can be used at plot, farm or landscape levels. However, it is much more effective at landscape level.

Suitable land use type and agro-ecology: Bench terrace can be implemented in various land uses including degraded cultivated land, degraded pasture/grazing lands and forest lands. Bench terrace is constructed in all agro-ecologies of the country. Bench terraces are level along the contour in dry to moist agroecological zones to reduce soil erosion and conserve soil moisture. In wet agroecological zones, they are graded to reduce soil erosion and drain excess runoff sideways to the next waterway.

*Limittaions: it r*equires huge labor/machinery costs/ for construction

Stone wall bench terrace in Endamehoni (Tigray region), photo credit by Zenebe Adimassu

Bench terrace cultivated with fruits and pulses in Dewey Harwa woreda *Amhara region), photo credit by Seid Getaneh

Stabilized Bench Terrace in Gumer woreda (SNNP region), photo credit by Dereje

Stone bench terrace at Haramaya woreda (Oromia region), photo credit by Yatu Chalesa

2. Hillside terrace

Short description: Hillside terraces are physical structures constructed along the contour, generally suitable in steep graded slopes and shallow soils (although common in other type of soils), suitable for tree planting and rather effective in controlling runoff and erosion. It is common in most parts of Ethiopia, generally in dry areas to support area closure plantation and protect downstream fields.

Environmental/climate risk to be addressed: Good potential to improve degraded hillside-mostly for area closure and multi-purpose tree and fodder tree plantations. When combined with sound moisture conservation (trenches etc) and proper management it can significantly improve watershed rehabilitation, biomass production and recharging of water tables.

Scale to be used: Hillside terrace is more effective when implemented at landscape level.

Land use types and agro-ecology: cultivated land, forest land, pasture/grazing land Hillside Terrace can be applicable in steep hillsides community closures with steep slopes that are highly degraded (Non vegetated) or degraded grassland. However, In dry areas and shallow soils need to be combined with other measures (trench etc). It is common in most parts of Ethiopia, generally in dry areas to support area closure plantation and protect downstream fields.

Limitations: it requires huge labour and material (rock/stone) cost. Regular maintenance is required for better stability of the terrace.

Hillside terrace Kelem Wollega (Oromia region), photo credit by Wakgari Workneh

Hillside terrace at Ebinat woreda (Amhara region), photo credit by Getahun Asmamaw

3. Hillside terrace with trench (HTTs)

Short description: HTTs is highly labour intensive that combine both effects of hillsides and trenches constructed immediately above the terrace stone riser, generally suitable for steep slopes (up to 50%) and shallow to medium depth soils (although common in other type of soils).HTTS is suitable for tree/shrubs planting and very effective in controlling runoff and erosion. Hillside Terrace with trenches ensure protection of downstream fields and play a significant role in replenishing water tables.

Environmental/climate risk to be addressed: Good potential to improve degraded and steep hillsides - mostly for area closure and multipurpose tree and fodder tree plantations. HTTs are water harvesting structures that can increase productivity of area closures and convert hillsides into agroforestry systems. Good effect on raising water table.

Scale to be used: plot level, landscape level or both: Hillside terrace with trenches is more effective when implemented at landscape level.

Land use type and agroecology: Cultivated land, forest land, pasture/grazing land: Hillside Terrace with trenches can be applicable in steep hillsides with soils with low infiltration capacity and high levels of stoniness and for community closures. It is suitable mostly in semi-arid and arid parts of the country. Recently, it introduced in Kolla and Dry Weyna-Dega areas for the growth of trees, catchment treatment and support to area closure. However, Design of trenches can be changed based on dryness conditions and type of plantations

Limitations: HTTs is very labour intensive. It also Requires maintenance, if not well constructed and stabilized.

Hillside terrace with trench Kersa woreda Oromia, photo by Adinan Mohamed

Hillside terrace with trench in Amhara Gazgibla woreda) photo by Enideg Dires

4. Eye brow basin

Short description: Eye brow basins (EBB) are larger circular, and stone faced (occasionally added) structures for tree and other species planting. Based on experience they are effective in low rainfall areas to grow trees and harvest moisture. Eyebrow basin can be constructed in slopes above 50% for spot planting. It controls runoff and contribute to recharge of water tables.

Environmental/climate risk to be addressed: Soil erosion and soil moisture stress

Scale to be used: **plot/farm, landscape (most suitable)**

Suitable land use types and agroecology: can be implemented in cultivated land, forest land, pastureland/grazing land Good potential to improve degraded and steep hillsides mostly for area closure and multipurpose tree and fodder tree plantations Eyebrow Basin can be combined with other measures such as hillside terraces, stone bunds, and trenches based upon soil, slope and stoniness. The practice can also be applied inside large gully areas for tree planting. EBBs are uitable in degraded areas, mostly in semi-arid and medium rainfall areas with shallow soils. Commonly practiced in dry and moist weyna dega areas for the growth of trees and support to plantations in area closure

Limitations: EBBs are labour intensive. It requires maintenance if not well constructed and stabilized.

Eyebrow Basin in Endamehoni (Tigray region), photo credit by Zenebe Adimassu

Eyebrow/stone wall half-moon at Ebinat woreda Amhara Region, photo credit by Mame

Stone-faced eye-brow basin with terrace in Kersa woreda (Oromia region, photo credit by Adinan Mohamed

5. Level soil bunds

Short description: Level soil bunds: where the soils are excavated and placed at the downhill and form soil embankments across the slope to reduce soil erosion, conserve soil moisture. Level soil bund is suitable in area with low rainfall at various slopes. It can also be implemented in steep slopes to develop bench terrace gradually.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress

Scale to be used: farm, landscape (most suitable)

Land use types and agro-ecology: Implemented in Dry and moist Weyna Dega areas. These practices are applied on cultivated lands with slopes above 3% and below 15% gradient.

Limitations: Bunds can create temporary waterlogging , limited bund stability unless integrated with vegetative measures and it requires regular maintenance.

Level soil bund in Mengesh woreda (Gambella region), photo credit by Mikre Adane

Level soil bund stablised with grasses. Lemo woreda (SNNP region), photo credit by Zenebe Adimassu

6. Graded soil bunds

Short description: Graded soil bunds: where the soils are excavated and placed at the downhill and form soil embankments across the slope with 1% gradient to dispose excessive runoff, conserve soil and water resources. Graded soil bund is suitable in area with high rainfall, soil with low permeability and steep slopes to develop bench terrace gradually.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, excessive runoff, and flooding

*Scale to be implemented: very suitable at l*andscape scale

Suitable land use types and agroecology: constructed in cultivated land, grazing land and exclosure. This practice is suitable in various agro-ecologies such as all High Dega, Moist Dega, Wet Dega, Moist Wet Weyna Dega , Wet Weyna Dega, Moist Kolla and Wet Kolla

Limitations: Limited stability if not integrated with revegetation measures and requires regular maintenance.

Degraded soil bund Komo woreda woreda, Benishangu Gumuz region, photo credit by Henok B

Graded soil bund in Godere woreda, Gambella Region, photo credit by Mikre Adane

Graded Soil Bund, Quarit woreda (Amhara region), photo credit by Fetene Mekonen

7. Soil bund (level/graded) vegetated with forage grass

Short description: As for vegetated soil bund (level/graded) deep rooted and multi-purpose forage grasses and/or trees/shrubs (i.e. Densho grass, Lucinea, sesbania sesban) are planted on the embankments to strengthen the bund structure, reduce time taken to develop into bench terrace, and maximize additional benefits (i.e. feed, wood, carbon sequestration, soil fertility improvement) of the soil bund in a short and long term

Environmental/climate risk to be addressed: soil erosion, moisture stress, soil nutrient depletion, feed shortage

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses, particularly in cultivated lands with some level of free grazing. Applied mainly in Wurch, Wet dega, Wet Weyna Dega and Moist Dega, Moist Weyna Dega, Moist Kolla, Dry Kolla, Wet Kolla areas

Limitations: free grazing destroys forage/trees, harbours rodents and birds, requires regular follow-up and management of forrages/trees

Forage development on soil bund in Antsokia Gemiza Woreda, Amhara Region, photo credit by Mektew Alemu

Level soil bund vegetated with forage grass, Arbegona woreda, Sidama region, photo credit by Solomon Mengesha

8. Soil bund (level/graded) vegetated with Vetiver grass

Short description: As for vegetated soil bunds (level/graded), Vetiver grasses which is deep rooted and used for conservation merely rather than forage could be planted on the embankments to strengthen the soil bund, increase conservation efficiency and make the bund durable. It also develop soil bund into bench terrace gradually

Environmental/climate risk to be addressed: soil erosion, soil fertility depletion, moisture stress

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses, particularly in cultivated lands with some level of free grazing. Applied mainly in Wet dega, Wet Weyna Dega and Moist Dega, Moist Weyna Dega, Moist Kolla, Wet Kolla areas

Limitations: free grazing destroys the grass mainly during the dry season, harbours rodents and birds

Graded soil bund with Vetivar grass at Haru woreda, Oromiya region, photo credit by Leta Hailu

Soil bund (level/graded) vegetated with Vetivar grass, SNNPR region, photo credit by Solomon Mengesha

9. Stone-faced graded soil bund

Short description: Stone faced graded soil bunds are constructed by combining stone and stones and suitable in high rainfall areas (graded bunds). The stone are placed on lower side and soil filled on the upper side of bunds.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, excessive runoff, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. The practice is suitable in all high Dega, moist dega, Wet Dega, moist Wet Weyna Dega , Wet Weyna Dega, Moist Kolla, Wet Kolla and Moist Berha'

Limitations: requires labour and material (stone), limited stability and requires regular maintenance.

Stone faced graded soil bund in Wogera woreda, Amhara region, photo credit by Enideg Dires

Stone faced graded soil bund in Farta woreda, Amhara region, photo credit by Zenebe Adimassu

Stone faced graded soil bund in Lalo kile woreda, (Oromia region), photo credit by Bedassa Fetene

10. Stone faced soil bund (level/graded) with forage trees

Short description: As for vegetated stone-faced soil bund (level/graded) deep rooted and multi-purpose forage trees/shrubs such as Lucinea and sesbania sesban are planted on the embankments to strengthen the bund structure, reduce time taken to develop into bench terrace, and maximize additional benefits (i.e. feed, wood, carbon sequestration, soil fertility improvement) of the in a short and long term

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. Applicable in various agro-ecology (refer stone-faced soil bunds).

Limitations: it requires huge labour and material (stone, forage trees) cost, free grazing and it requires regular maintenance.

Stone faced soil bunds vegetated with trees in Farta woreda (Amhara region), photo credit by Zenebe Adimassu

Soil bunds vegetated with trees in Basona werana woreda (Amhara region), photo credit by Lulseged Tamene

11. Level fanya juu

Short description: A level Fanya Juu ('throw uphill' in Swahili language) is an embankment along the contour, made of soil and/or stones, with a basin at its lower side. The Fanya Juu reduces or stops the velocity of overland flow and consequently soil erosion. By contrast with the **level; soil bund**, the soil in a Fanya Juu is moved upslope for construction. The water retention basin is thus at the lower side of the wall.

Environmental/climate risk to be addressed: Soil erosion, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. It is suitable in various agro-ecologies including Moist High Dega, Dry Dega, Moist Dega, Dry Weyna Dega, Moist Weyna Dega, Dry Kolla and Moist Kolla

Limitations: it requires huge labour for digging and throwing the soil uphill.

Level Fanyaa juu in Kechema in Adama woreda (Oromia region), photo credit by Mohammed Rabo

Level soil bund Lemo woreda (SNNP region), photo credit by Zenebe Adimassu

13. *Fanya juu* (level/graded) vegetated with forage grass/trees

Short description: As to for vegetated *Fanya juu* (level/graded) deep rooted and multi-purpose forage grasses and/or shrubs (i.e. Densho grass, Lucinea, sesbania sesban) are planted on the embankments to strengthen the bund structure, reduce time taken to develop into bench terrace, and maximize additional benefits (i.e. feed, Carbon sequestration, soil fertility) of the soil bund in a short and long term

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. Applicable in various agro-ecology including It is suitable in various agro-ecologies including all High Dega, Moist Dega, Wet Dega, Moist Weyna Dega, Wet Weyna Dega, Moist Kolla, Wet Kolla and Moist Berha

Limitations: it requires huge labour for digging and throwing the soil uphill. *it requires planting material (forage trees) and free grazing a major limitation for the adoption of the practice*.

Fanya juu with forage grass in Amhara region, Basona warana(North Shewa) Woreda, by Antene h

14. Fanya juu (level/graded) with Vetivar grass

Short description: In vegetated *Fanya juu* (level/graded) with Vetiver grasses, the deep rooted Vetiver is planted on the embankments to stabilize the *Fanya juu* bund, increase conservation efficiency and develop long lasting structure. In addition, the grass can also be used to various purposes including construction and animal feed in some places.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. Applicable in various agro-ecology including It is suitable in various agro-ecologies including all Dega, all Weyna Dega, all Kolla and Moist Berha

Limitations: it requires huge labour for digging and throwing the soil uphill. it requires planting material and free grazing is a major limitation for the adoption of the practice

Forage grass strip at Antsokiya Gemza woreda, Amhara region, photo credit by Mekitew

15. Densho grass bund

Short description: Desho grass (Pennisetum pedicellatum) is deep rooted and used for animal feed. The grass is planted as hedge across the slope on the embankment of the level or graded soil bunds. The grass is a very palatable species to cattle and and sheep.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress, and feed shortage.

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, and grazing land. Applicable in various agro-ecology including It is suitable in various agro-ecologies including all Dega and all Weyna Dega areas of the country.

Limitations: it requires huge labour for digging and throwing the soil uphill. it requires planting material (desho grass) and free grazing is a major limitation for the adoption of the practice

Desho grass *(Pennisetum pedicellatum*) on cultivated lands in Lemo woreda (SNNP region), photo credit by Zenebe Adimassu

Desho grass (Pennisetum pedicellatum) on bench terrace in Gumer woreda (SNNP region), photo credit by Dereje

16. Soil faced deep trench bunds

Short description: Soil faced deep trench bund is constructed by excavating trenches of 1 m deep, 0.5 - 1 m wide and 2 - 3.5 m long with spacing between trenches of 0.3 - 0.5 m along the contour and using the excavated soil to construct a compacted bund downslope. These practices with smaller dimensions are usually used in cultivated lands while with larger dimensions are implemented in grazing lands and exclosure.

Environmental/climate risk to be addressed: Soil erosion, excessive runoff, soil nutrient loss; and water scarcity, soil moisture stress.

Scale to be implemented: It can be applied at farm and landscape (most applicable) scales

Land use types and Agro-ecology: Applicable in a broad range of land uses, particularly in cultivated lands with some level of stoniness. Suitable mostly in semi-arid and arid parts of the country. Recently introduced in kolla and dry weyna dega areas for the growth of trees, catchment treatment and support to exclosure..

Limitations: Require continuous maintenance and removal of sediment

Soil faced trench in Amhara region at at East-Belessa by Adinew Ambelu

Soil faced trench in Makouy woreda, Gambella region photo by Mikre Adane

17. Stone-faced level soil bund

Short description: Stone faced level soil bunds are constructed by combining stone and soil and suitable in low rainfall areas. The stone are placed on lower side and soil filled on the upper side which reinforced and stabilize soil bunds. Well constructed stone-faced level soil bunds offer strong resistance against runoff and conserves soil moisture insitu.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in a broad range of land uses including cultivated land, grazing land and forest land. The practice is suitable in low rainfall areas particularly Moist High Dega, Dry Dega, Moist Dega, Dry Weyna Dega,, Moist Weyna Dega, Dry Kolla, Moist Kolla, Moist Berha

Limitations: requires labour and material (stone), limited stability and requires regular maintenance.

Stone faced level soil bund in Amhara region, Wogera woreda by Yaregal Fiseha

Stone-faced level soil bund in Oromia region, Wara Jarso woreda by Bonsa Lemi

18. Stone faced level soil bund with trench

Short description: A structure in which stone faced level soil bunds combined with trenches of various sizes at a certain intervals. A trench is a short ditch dug along the contour (i.e. across the slope) to trap runoff water in dry and moist areas. In the degraded lands, the trees will be planted in a planting pit in the centre of the trench. Trenches are particularly useful to help rehabilitate degraded lands.

Environmental/climate risk to be addressed: Soil erosion and soil moisture stress.

Scale to be implemented: Applied at farm and landscape scales

Suitable Land use types and agroecology: Applicable in a broad range of land uses, particularly in degraded cultivated lands, grazing lands, forest lands and exclosure areas. Can be applied in various agroecology including Dry Dega, Moist Dega, Dry Weyna Dega, Moist Weyna Dega, Dry Kolla and Wet Kolla.

Limitations: it requires continuous maintenance of the bund as well as the trench

Stone-face level soil bund with trench in in Endamehoni (Tigray region), photo credit by Zenebe Adimassu

Stone-faced soil bund with in Kersa woreda, Oromia region, photo credit by Adinan Mohamed

19. Graded/level stone-faced soil bund stabilized with grasses

Short description: Grasses are planted on the embankment of graded/level ston-faced soil bunds to stablize the bund and increase animal feed availability. For this purpose grasses that can grow easily, stabilize the soil bund, bring benefits to farmers can be selected. The most common grasses for such purpose include desho grass, elephant grass, veriver grass and falaris.

Environmental/climate risk to be addressed: Soil erosion, soil fertility depletion, excessive runoff, moisture stress, feed shortage.

Scale to be implemented: Applied at farm and landscape scales

Suitable Land use types and agroecology: Graded/level stone-faced soil bund stabilized with grasses applicable in a broad range of land uses in which, predominantly in cultivated lands with some level of stoniness. Graded/level stone-faced soil bund stabilized with grasses applicable to most agro-ecological zones with virtual stabilization of the structures.

Limitations: it requires huge labour for constriction of bunds and materials (stone, grasses) and follow-up, Free grazing is also a critical limitation for the adoption of grasses on bunds.

Stone faced soil bund with grass in Amhara, Antsokiya Gemza woreda by Mekitew

Stone faced soil bund with grass in Qersa woreda, Oromia region photo by Adinan Mohamed

20. Graded/level stone-faced soil bund stabilized with trees

Short description: In this case, trees are planted on the embankment of graded/level ston-faced soil bunds to stablize the bund, increase animal feed availability and wood biomass. For this purpose trees that can grow easily, stabilize the soil bund, bring benefits to farmers can be selected. Acacia salgina, Sesbania sesban, willow and Tree Lucerne are most commonly used trees as bund stabilizer in various agroecology.

Environmental/climate risk to be addressed: Soil erosion, soil fertility depletion, excessive runoff, moisture stress, feed shortage, wood shortage.

Scale to be implemented: Applied at farm and landscape scales

Suitable Land use types and agroecology: Graded/level stone-faced soil bund stabilized with trees applicable in a broad range of land uses in which, predominantly in cultivated lands with some level of stoniness. Graded/level stone-faced soil bund stabilized with trees applicable to most agro-ecological zones (depending on suitability of trees) with virtual stabilization of the structures.

Limitations: it requires huge labour for constriction of bunds and materials (stone, trees) and follow-up, Free grazing is also a critical limitation for the adoption of trees on bunds.

Tree lucerne planted on graded stone-faced soil bunds in Farta wereda (Amhara region), photo credit by Zenebe Adimassu

Soil bunds vegetated with trees in Basona werana woreda (Amhara region), photo credit by Lulseged Tamene

21. Micro-basin

Short description: A microbasin is a small structure with the shape of a half or a full circle, excavated to obtain a small basin for planting a tree. Microbasins vary in size according to their designation to conserve water; they are small in moist agroecological zones and large in dry ones.

Environmental/climate risk to be addressed: Soil erosion, nutrient losses, moisture stress,

Scale to be implemented: farm, landscape (most suitable)

Suitable land use types and agroecology: Applicable in degraded lands mainly exclosure and degraded forest lands. The practice is suitable in various agro-ecology such as Moist High Dega, Dry Dega, Moist Dega, Dry Weyna Dega, Moist Weyna Dega, Dry Kolla and Wet Kolla.

Limitations: requires huge labour for construction and maintenance.

Microbasin in Oromia region t Bedele woreda by Nibras Ahmed

Microbasin in Ebinat woreda, Amhara region photo by Mame

22. Wooden check dam pond

Sort description: It is a small pond developed by wooden checkdams. A check dam is constructed mainly on gully courses to harvest surface runoff water and control gully erosion. Check dam pond developed with check dams store water for future use and recharge groundwater such as the surrounding wells.

Environmental/climate risk to be addressed: Soil erosion, excessive runoff, water shortage,

Scale to be implemented: landscape scale is most appropriate

Suitable land use types and agroecology: Applicable in any land use where gully erosion is predominant. The practice is suitable in various agro-ecology such as Moist High Dega, Dry Dega, Moist Dega, Dry Weyna Dega, Moist Weyna Dega, Dry Kolla and Wet Kolla.

Limitations: The main limitation of check dam pond is that it requires considerable quantities of wood and labour for transport as well as construction. It also *requires technical knowhow to design and construct the check dam and apron, scoring and further gully formation unless properly designed.*


Check-dam pond in , Bure zuria woreda (Amhara region), photo credit by Melsew Mengistu

23. Sandbag check-dam

Short description: Sandbag check-dams are temporary structures constructed by filling the sand in bags and piling them across large rills or small gullies up until the desired height levels. The bags are piled up usually to a maximum of 3 – 4 layers to form a small check-dam. The bags used for the purpose are either used jute or polyethylene bags of 50 -100 kg. It is also a very good technology for controlling gully.

Environmental/climate risk to be addressed: Sand bag check dam Reduces erosion and accumulate soil sediments used for re-vegetation. the Gullies can be reclaimed for production of trees (including fruits) and crops as a result of controlling run-off and conserve moisture in the soil. In Ethiopia, large tract of farmlands and grazing areas are reclaimed with the application of sand bag check-dams.

Scale to be used: The practice can be implemented in plot/farm and landscape levels. However, it is more effective at landscape level

Land-use type and agroecology: The practice can be applied in all land use types including cultivated, grazing and degraded forest/shrub lands) where only smaller/medium gullies exist and where sand is available. Sandbag check-dams are suitable alternative technologies for every agro-ecology of many areas provided stones, wood and other materials are not available in the area to use other types of check-dams.

Limitations: The technology is not applicable in large gullies and in areas where there is shortage of vegetative materials.

Sandbag checkdam in Takusa woreda, Amhara region, photo credit by Angaw Zewdu

24. Loose rock check-dam

Short description: Loose rock check-dam is a structure made of relatively small rocks and placed across the gully or small stream, which reduces the velocity of runoff and prevents the deepening and widening of the gully. Sediments accumulated behind this check-dam could be planted with crops or trees/shrubs, grasses and thus provide additional income to the farmer. The main purpose here is to stabilize and rehabilitate gullies and convert into productive land. The loose stone check dam reduces erosion and consequently accumulates soil sediments used for re-vegetation including for production of trees (including fruits) and crops by conserving moisture in the soil.

Environmental/climate risk to be addressed: Gully erosion

Scale to be used: The technology can be implemented in plot/farm and landscape levels. However, it is more effective at landscape level.

Land-use type and agro-ecology: Loose rock check-dams is commonly used to check /control gully erosion on highly eroded grazing and cultivated lands as well as forest/bush land where gully erosion is a problem.

Limitations: loose rock check-dams are effective to plug small gullies and not effective for large gullies.

Loose rock Checkdam in Chilga woreda , Amhara region, photo credit by Daniel Tegegn

Loose rock check-dam in Amhara Region, photo credit by Shibabaw Goshu

Loose rock checkdam in Oromia region, Kelem Wolega by Mubarek Ahmed

25. Live check-dam

Short description: Live check-dams are established by planting/ seeding or plugging of cuttings/grassess in gully bottoms to replace or reinforce physical check-dams. The main objective of the establishment of live check-dams is to reduce the cost of establishing physical check-dams.

Environmental or climate risk to be addressed: gully erosion, feed shortage

Scale to be used: plot/farm and landscape levels

Land use types and agro-ecology: The technology can be applied in all land use types (farmlands, grazing lands and degraded forest/shrub lands) and well adapted with gullies and dry river beds with low to medium slopes. The technology can be effective if combined with loose rock or brush wood check-dams where there is good availability of vegetative material The technology can be applied in any agroecology provided where there are gullies and dry riverbeds with low to medium slopes.

Limitations: The challenge might be the availability of vegetative material of fresh stem of plant for horizontal planting on the gully bed.

Gully rehabilitation using live checkdam in Hawassa Zuria woreda (Sidama region), photo credit by Esayas

26. Stone wall check-**dam**

Short description: Stone wall check-dam is a structure of masonry that constructed on gullies watercourse to trap sediments and protect gullies from further expansion due excessive surface runoff. Stone wall check-dam is applied to trap sediments and to fill and make the gullies productive land again.

Environmental or climate risk to be addressed: Gully erosion and excessive runoff and water pollution due to nutrient loss from cultivated lands

Scale to be implemented: It can be applied at farm and landscape scales

Land use and agro-ecology: The technology can be applied in all land use types such as cultivated lands, grazing lands and degraded forest/shrub lands and well adapted with gullies and dry river beds with low to medium slopes. It can be applied in all agroecologies where stone is abundantly available.

Limitations: The main limitation of check dam is that it requires considerable quantities of loose stone and intensive labour for construction. Limited expertise to design and construct effective check dams.

Stone wall check-dam at SeKella woreda (Amhara region), photo credit by Shibabaw Goshu

27. Brush wooden check-**dam**

Short description: Brushwood check-dams made of posts and brushes are placed across the gully. The main objective of brushwood check-dams is to hold fine material carried by flowing water in the gully and stabilize active small gullies. Brushwood check-dams are temporary structures and should not be used to treat ongoing problems such as concentrated run-off from roads or cultivated fields. It can be constructed by vegetative materials and twigs. Plant species which can easily grow vegetative through cuttings are ideal for the purpose.

Environmental or climate risk to be addressed: Gully erosion and excessive runoff and water pollution due to nutrient loss from cultivated lands

Scale to be implemented: It can be applied at farm and landscape scales

Land use and agro-ecology: The technology can be applied in all land use types such as cultivated lands, grazing lands and degraded forest/shrub lands and well adapted with gullies and dry river beds with low to medium slopes. It can be applied in all agroecologies where brush wood available.

Limitations: The main limitation of check dam is that it requires considerable quantities of wood and intensive labour for construction. It cannot be applicable in large gullies and in areas where there is shortage of wood.

Brushwood check-dam in Bure zuriya (Amhara region), photo credit by Melisew Mengistu

28. Gabion check-**dam**

Short description: Gabions are rectangular boxes of varying sizes and are mostly made of galvanized steel wire woven into mesh. The boxes are tied together with wire and then filled with either stone or soil material and placed as building blocks. Gabions are filled in situ and as they are very heavy they will not be washed away provided they have been correctly installed. The purpose is to stabilize and rehabilitate gullies and convert gullies into productive land. The main advantages of gabion check-dams are that they are tough and long lasting provided that the wire has been well galvanized.

Environmental or climate risk to be addressed: Soil erosion in gully form, excessive surface runoff, nutrient losses that could pollute water bodies, GHG emissions

Scale to be implemented: It can be applied at landscape and plot/farm scales, but very suitable at landscape scale

Land use and agroecology: Gabion check-dams are suitable in all kinds of agro-ecologies where gullies are formed and extended. Gabions can be constructed with stone in area where stone is available.

Limitations: The major limitation of these types of check-dams is that it is very costrly in relation to the gabion boxes which cannot be afforded by small holder farmers. It also requires skill to design and construction.

Checkdam in Debark woreda, Amhara region, photo credi by Alemu Birhanie

Gully head treatment using gabion in Endamehoni woreda, Tigiray region, photo credit by Zenebe Adimassu

29. Biological gully rehabilitation

Short description: Gully stabilization using biological measures is a conservation structure that uses vegetation materials such as trees and grasses for gully control. The gully vegetation can be established artificially by a human being and naturally by creating favourable environment for slow recovery.The vegetation helps to protect the gully floor and banks from scouring and benefit communities' trough provision of grass and tree products.

Environmental/climate risk to be addressed: Gully erosion, excessive runoff, feed shortage, pollution and nutrient depletion

Scale to be used: It can be at plot/farm level and landscape level

Land use and agroecology: Gully stabilization using biological measures can be implemented in several land use where gully erosion is a problem

Limitations: if the gully sides are steep, vegetation may not be established easily. It may be also difficult to be successful where free grazing is a common.

Gully stabilization using vegetation (Tree Lucerne) Dendi woreda, Oromia region, photo credit by Zenebe Adimassu

Gully stabilization using vegetation in Bure Zuria Wereda, Amhara region, photo credit by Melsew

Gully revegetation combined with microbasin structures in Kechema worega, Oromia region, photo credit by Bayu

Gully revegetation in Baso Liben wereda, Amhara region, photo credit by Enideg Diressworeda

30. Gully wall re-shaping and revegetation

Short description: Gully wall reshaping is a conservation structure where a steep slope is converted into a gentle slope by cutting off active gully flunks. Once the slope is reduced, trees/grasses can be planted to stabilize the gully bed and sides.

Environmental/climate risk to be addressed: Gully erosion, excessive runoff, feed shortage, pollution and nutrient depletion

Scale to be used: It can be at plot/farm level and landscape level

Land use and agroecology: Gully stabilization using biological measures can be implemented in several land use where gully erosion is a problem

Limitations: If the gully sides are steep, vegetation may not be established easily. Free grazing of livestock affected the survival of vegetation.

Gully wall reshaping and revegetation in Jimma (Oromia region), photo credit by Leta Hayilu

31. River bank stabilization

Short description: River bank stabilization is a conservation structure where river erosion is the scouring of soil material from the river bed and cutting of the river banks by the force of water running from the stream. Hence, vegetation removal due to overgrazing and tillage close to the banks will increase river-bank erosion.

Environmental/climate risk to be addressed: Stabilize soil, conserve moisture and promote plant growth

Scale to be used: River bank stabilization can be used at landscape level

Lan use and agroecology: River bank-stabilization implemented in the stream or shoreline locations. The river bank stabilization is suitable in most agro-ecological zones, especially in the area where watershed management actions are weak.

Limitation: it requires continuous management of trees

River bank stabilization and management in Amhara region, photo credit by Dessie Adane

32. Stone paved waterways

Short description: A waterway is a natural or artificial drainage channel constructed along the steepest slope to receive/accommodate runoff from cut-off drains and graded terraces/bunds. The waterway carries the run-off to rivers, reservoirs or gullies safely without creating erosion. Paved waterways are suitable in steeper terrains and areas with large amount of stones. A vegetative waterway is constructed in areas where stone is not available. It is applicable in areas where excess water is generated, during heavy rains which are beyond the intake capacity of soils. The excess water is disposed safely to natural outlets. Waterways are established a year or two before cut-off drains and field structures are constructed.

Environmental/climate risk to be addressed: Generally, Contribute to increased sustainability of production through disposing excess runoff from cultivated fields and other sources of run-off from upstream. In addition, it helps to reduce soil erosion and gully formation

Scale to be used: farm/ landscape scales. Paved waterway is more effective when implemented at landscape level where large amount of stone are available in the area.

Land use and agroecology: Harvesting technology suitable in locations where there is enough catchment area that supply water to be stored in the soil or storing structure. Although needs to be constructed in lower catchment areas (farm, grass and communal lands) with a slope of less than 5% for protection or reducing erosion. It is applicable in all agro-climatic conditions, particularly in moist areas and areas prone to waterlogging. The use of grass vegetation in waterways is commonly practiced locally by farmers. However, paved waterways are suitable in steeper terrains and areas with large amount of stones.

Limitation: The main limitation include that it requires considerable quantities of stones and labour.

Stone paved waterway in Danigla woreda (Amhara region), photo credit by Arega Alemu

33. Cut-off drains

Short description: A cutoff drain/ diversion ditch is a graded channel constructed to intercept and divert the surface runoff from higher ground/slopes and protect downstream cultivated land, village, agricultural infrastructures like irrigation headwork and active gully heads. Cutoff drain safely diverts the runoff to a natural or artificial waterway, river, or run-on areas.

Environmental/climate risk to be addressed: Soil erosion and flood from upstream areas.

Land use and agro-ecology: If it is intended to protect cropland against runoff from adjoining non-arable land, it should be constructed at the boundary between the two land uses where there is a slope change. Cutoff drains are most suitable in areas where there is medium to high rainfall distribution. They can be also used in dry areas to protect cultivated lands and irrigation schemes, and divert runoff into run-on areas, for example reservoirs and farmlands

Scale to be used: farm and landscape scales

Limitations: If a cutoff drain breaks because of poor layout and construction, it will have a devastating effect to the downstream areas. Gullies may develop from it.

Cut-off drain in Mengesh woreda (Gambella region), photo credit by Mikre Adane

II. Agronomic SLM/CSA practices

34. Residue mulching

Short description: Mulching is the covering of the soil with crop residues such as straws, maize/sorghum stalks or standing stubble. Mulching, in addition to its positive effects on soil structure also helps in reducing evaporation and maintenance of soil moisture. The improved soil structure also increases water holding and moisture retention capacity of soils and consequently higher water budgets for the growing crops. Crop residue management provides seasonal soil protection from wind and rain erosion, adds organic matter to the soil, conserves soil moisture, and improves infiltration, aeration and tilth In Ethiopia Mulch is applied in several areas around high value cash crops such as fruit trees, coffee, etc to conserve moisture and also to improve soil conditions.

Environmental/climate risk to be addressed: control soil erosion, conserve moisture, and improve soil fertility,

Scale to be used: mulching and crop residue can be applied at plot, farm and landscape level. However, it is much more effective at plot level.

Suitable land use type and agro-ecology: The suitability of mulching for soil fertility and productivity improvement greatly varies under different ecological conditions. In cool wet areas the rate of decomposition is low, and it may cause water lodging and reduce soil temperature. In the low dry environment again the rate of decomposition could be retarded by low moisture conditions. Thus, it appears most appropriate in warm and moist environment for both erosion control and optimal soil fertility and productivity improvement

Major challenges: competition of crop residue for animal feed coupled with the traditional free grazing system. Hence, only few farmers leave cereal residue in the field specifically for soil amendment. Residue left on the soil might however also be grazed during the dry season or eaten by termites. In addition, the lack or inadequate awareness of the role of the technology on erosion control, soil fertility and productivity improvement on the part of farmers and the limited skill, knowhow and commitment on the part of technical staff appear another major limitation for the promotion of the technology in our country.

Crop residue mulching in Bibugn Woreda, Amhara region, photo by Negesse Mune

Crop residue mulching in Mengesh woreda, Gambella Region,photo by Mikre Adane

35. Cover/Green manure crop

Short description: Cover crops- are crops grown as ground protection as conservation measure on fallow lands during off-season. Cover crops provide proper ground cover to protect the soil from erosive agents. While the main objective of cover crops is to protect the soil from the direct impact of erosive agents, they also play additional role of replenishing soil organic matter and nutrients. Cover crops are grown for permanent soil cover, as part of the three principle of conservation agriculture, in the area where there are shortage of crop residue or mulching, after the main crop have been harvested. While green manure crops are crops grown mainly to maintain or increase the soil organic matter and nutrients. In addition, the crops protect the soil against erosion during off-season.

Environmental/ Climate risk o be addressed: soil erosion, decline soil fertility and land productivity. Hence this practice reduces soil erosion, improves soil fertility and increase land productivity

Scale to be used: The practices can be used at plot, farm and/or landscape levels

Suitable land use type and agroecology: The practice is more suitable in degraded cultivated lands with bimodal rains where the crops are grown during the small rains and the material incorporated into the soil at the beginning of big rains. This technology is less applicable to the dry agro-ecologies where the duration of the Meher rains and amount of Belg rains do not allow enough growth of cover/green manure crops that would be ploughed in before planting of the main crops. However, the technology is applicable to dry areas with supplementary irrigation.

Major challenges: the major challenge is the lack of exposure of our farmers to the technology and limited skill, knowledge and experience on the part of extension staff to facilitate the initiation and expansion of the technology in different parts of the country. Also the limited availability of suitable planting materials could be a limiting factor.

Cover crop in Gimbo woreda (Southwest Ethiopia region), photo credit by Solomon

Green manuring in Bure zuria woreda (Amhara region), photo credit by Melsew Mengistu

36. Conservation tillage

Short description: "Conservation tillage (CT)' is any tillage and planting system that covers 30 percent or more of the soil surface with crop residue, after planting, to reduce soil erosion by water. The soil is undisturbed by tillage during the entire year. Crop residues left on the soil surface may be disturbed in strips up to one-third of the row width for planting or drilling seed. The most common tillage practices include no-till, strip-till, in-row subsoiling and ridge till.

Environmental/climate risk to be addressed: soil erosion is the primary concern while soil fertility depletion can be addressed through conservation tillage

Scale to be used: conservation tillage can be applied in plot, farm and landscape levels. However, landscape/community level is more suitable for collective action to address the issue of free grazing

Suitable land use types and agroecology: The technology can be implemented in high and low potential Cereal zone (intermediate with > 180 days growing period and high rainfall variability with 90-150 days growing period). It can be adapted and used in all agro-ecological zones with certain modifications (e.g with tied ridges) based on soil and crop types and socio economic and cultural condition. In addition, can be scaled up in Agropastoral and pastoral dry areas where rainfall is limited and the growing period is too short for most crops.

Major challenges: the main challenges of CT include free grazing of livestock, competition for crop residues between livestock (fodder) and mulching for CT, lack of planter/driller for smallholder farmers and weed infestation

Conservation tillage in Oromia, Sigmo by Girmum Kebede

Conservation tillage Urg woreda, Benishangul Gumuz région, photo by Dereje chernet

37. Intercropping

Short description: Intercropping is a practice of growing two or more crops simultaneously in the same plot in a fixed pattern in one season. The various leaf arrangements of different plants allow light to be better intercepted over time. The contrasting patterns of root growth, which utilize different soil layers, optimize the use of available soil moisture and nutrients. Mixed stands protect the soil surface more effectively than pure stands. In areas where row crops such as maize and sorghum cultivated, the area remains exposed to erosive forces and the soil is subject to soil erosion. Moreover, the stalks of these crops are often removed for various purposes, thus there is very little return of nutrients to the soil. To contrast this nutrient mining system, suitable legume species (chickpeas, cowpeas, beans, green gram, pigeon peas, soybeans, forage legumes, etc.) should be planted in the spaces left between rows.

Environmental/climate risk to be addressed: soil fertility decline, low crop/land productivity, weed/insect infestation

Scale to be used: Intercropping can be used at plot/farm or landscape levels. However, it is much more effective at plot/farm level.

Suitable land-use types and agroecology: applicable in cultivated land and agroforestry systems, mostly crop-livestock system in most of the agro-climatic conditions, and often practiced in Ethiopia in mid altitudes where the amount of annual rainfall ranges between 700-1200 mm. In moisture deficit areas and the practice seems to be more feasible for row crops such as maize and sorghum, or cotton. In low rainfall areas it needs to be integrated with soil and moisture conservation practices such as tie-ridging and mulching.

Major challenges: It requires row-planting equipment otherwise cost of labour is expensive. Limited knowledge on the optimum combination of crops to be intercropped

Intercropping of maize and beans in Dawa Chefa woreda, Amhara Region, photo credit by Tefera Bayissa

Intercropping of cabbage and pepper in Yilmana Densa wereda, Amhara region, photo credit by Kassahun

38. Acid soil management and liming

Short description: Low soil pH and associated soil infertility problems are considered to be amongst the major challenges to crop production in the Ethiopian highlands. Once a soil is found to be acidic, it requires correcting its acidity either though chemical amendment such as liming through the modification of soil reaction to a favourable condition to grow most crops. Research results show that productivity improvements ranging from 50% to 100% achieved through liming in wheat, barley, Teff, soybean and maize under moderate to severe acid soil conditions

Environmental/climate risk to be addressed: Soil acidity, low crop productivity

Scale to be used: the practice can be used: at plot, farm and landscape levels

Suitable land use and agroecology: Cultivated lands where the soil is affected by acidity and where the use of lime showed significant improvement in crop yields.

Limitations: The major limitation the cumbersome nature of the material for handling and application. Moreover, getting the most effective material (the quality and effectiveness) could be a limiting factor.

Acid soil management with lime in Hulet iju Ense woreda (Amhara region), photo credit by Abraham

Lime application in Omonada woreda (Oromia region), photo credit by Jemal Mujahid

Lime application in Arbegona woreda (Sidama region), photo credit by Abraham

39. Compost making

Short description: Compost is rich in nutrients and can be used for gardening, horticulture, and agriculture. To promote compost making at household level for cost-effective soil fertility improvement and to support local level compost entrepreneurship linked to natural resources management activities at watershed level. it will also improve soil fertility, increase water storage within the soil profile and reduce surface runoff, thus reduce soil erosion.

Environmental/climate risk to be addressed: soil nutrient depletion and low crop productivity

Scale to be used: plot/farm scale

Land use type and agroecology: Compost can be applied for high value crops within homesteads (horticulture), to fertilize conserved fields and/or supplement artificial fertilizers in cultivated lands treated by bunds/terraces and around valuable trees plantations. Compost can be prepared within all agro-ecology zones by using different methods such as pit method and heap method. The method is suitable in moist 'dega' (highland) and 'weyna dega' (intermediate) areas, but less suitable in 'kolla' (dry).

Limitation: huge quantity material is required to satisfy small plot of land, shortage of water for compost making and transportation from homestead to the outfield

Improved compost making in Omonada woreda (Oromia Region), photo credit by Jemal Muhajid

Improved compost making in Bure zuria woreda (Amhara region), photo credit by by Melsew Mengitu

40. Vermicompost

Short description: Vermicomposting is a method of making compost, with the use of earthworms, which generally live in soil, eat biomass & excrete it in digested form. This compost is generally called vermicompost or wormicompost. Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner.[3] It is used in gardening and sustainable, organic farming. Due to high quality compost production, application of vermicompost favours condition to produce high yield food crops because of which more atmospheric Carbon will be sequestered & the soils become more fertile & resilient against any possible climatic shocks.

Environmental/ Climate risk to be addressed: soil fertility decline and low crop productivity

Scale to be used: plot/farm level, landscape scales. Vermicomposting can be much more effective when applied at plot/farm.

Land use type and agroecology: cultivated land, forest land, pasture land/grazing land. Compost can be prepared within all agro-ecology zones. However, excellent quality of vermicompost can be produced in ambient temperature condition in a short period of time. Vermi-compost can be applied for high value crops within homesteads (horticulture), to supplement artificial fertilizers in cultivated lands and around valuable trees crops such as coffee, avocado, mango, etc.

Limitation: the main limitations include lack of knowledge, low awareness about vermiworms, limited feed for vermiworms and weather fluctuation

Vermicompost preparation in Omonada woreda (Oromia region), photo credit by Jemal Mujahid

Vermicompost production Lay Armachiho woreda (Amhara region), photo credit by Kasaw

41. Berken Maresha Plow

Short description: Berken Maresha combines different characteristics of the traditional maresha and introduces improvements and enables farmers to undertake consecutive tillage operations along the same direction. Its wide hollow central part enables to create a small ridge as opposed to the traditional plough which creates a valley along the line of ploughing. The raised part is furrowed up to 19 cm deep (as compared to about 10 cm of the traditional maresha) making it suitable for penetration of seed roots without inverting the soil. While at the same time it eases penetration of water deeper than normal plough thereby enabling water conservation. Berken Maresha has also sharp flanking metal parts which could rip grass roots and hard crusts up to 2 cm. This has the advantage of reducing labour need during ploughing as well during weeding.

Environmental/ Climate risk to be addressed: Soil erosion, runoff, low infiltration, hardpan

Scale to be implemented: can be applied by any scale including plot/farm and landscape scales

Land use and Agroecology: Applicable in cultivated lands in all agroecologies where soil erosion, runoff, low infiltration and hardpan development are major problems

*Limitations: Limited a*vailability of the Berken maresha in the market

Berken plow for deep tillage in Kulumsa (Oromia region), photo credit by Abera Assefa

Winged Berken plow for deep tillage in Kulumsa (Oromia region), photo credit by Abera Assefa

42. Tied-ridge

Short description: Tied ridging is a conservation structure where small rectangular chain basins are formed within the furrow, especially in agricultural lands, for surface storage increase and give rainfall infiltration time to the soil.

Environmental/climate risk to be addressed: Improve productivity, conserve moisture, and improve soil fertility

Scale to be used: Tied ridging can be used at plot, farm or landscape level.

Suitable land use type and agroecology: Tied ridging is suitable mostly in agricultural lands with gentle slopes. Tied ridging is suitable mostly in semi-arid and arid agro-ecological parts of the country. It can also be adopted where the rainfall amount is variable and small.

Limitation: Need to be constructed every season during planting.

Tied ridging in Adulala (Oromia region), photo credit by Fitih Ademe

43. Crop Rotation

Short description: Crop rotation is a cropping system where different crops are grown one after the other in the same plot of land. Crop rotation is traditional and the oldest known practice in which farmers have been growing cereals and pulses in rotation manner. The practice improves soil fertility, increase crop productivity, enhance crop diversification, control crop disease, pest and weed. The practices also enhance crop diversification. disease and restoring soil fertility.

Environmental/climate risk to be addressed: soil fertility depletion, soil moisture stress, low crop productivity, pest/weed infestation.

Scale to be used: Crop rotation can be practices at plot/farm and landscape scales.

Suitable land use type and agroecology: In Ethiopia crop rotations are an inherent farming system and it is suitable to cultivated lands and can be applicable in all agroecology.

Limitation: shortage of land for basic food crops and low yield of most pulse crops limit the use of cereal vs pulses rotation.

Crop rotation where Maize was rotated with Faba bean in Urga Woreda (Oromia region) photo credit by Girum Kebede

III. Agroforestry and Forest management

44. Scatter trees on farmlands

Short description: Trees on the farm are one of the forms of agro-forestry systems where trees are dispersed widely, either spaced systematically in a grid or scattered at random. On-farm trees integration is an old practice in many parts of Ethiopia and indispensable to sustain a green cover on the land throughout the year, increasing food and fodder production sustainably to improve the livelihoods of smallholder farmers and to sustain the natural resources upon which they depend

Environmental/climate risk to be addressed: Soil fertility depletion, wood shortage, soil erosion, moisture strees, shortage of livestock shade

Scale to be used: Scattered trees on farmland can be used at plot/farm or landscape levels. However, it is much more effective at landscape level

Land use type and agroecology: As the name of the practice indicates, the main land use can be cultivated land, though the practice can be combined with pasture/grazing land. This practice as one form/type of Agro-forestry is applicable to most of the Dega, Woina-Dega and Kola agro-ecologies. There are numerous multipurpose tree species that fit to the context of the various agro- ecological zones of Ethiopia

Limitation: free grazing, low survival of trees due to moisture stress in dry olla agroecology, harbour rodents and birds

Scattered trees on farmlands Sigmo Woreda in (Oromia region), photo credit by Girum Kebede

Scattered fruit trees on bench terrace in Delanta woreda (Amhara region), photo credit by Arega Alemu

45. Alley cropping

Short description: Alley cropping also known as hedgerow intercropping, involves managing rows of woody plants with annual crops planted in alleys in between. The woody plants are cut regularly and leaves and twigs are used as mulch on the cropped alleys in order to reduce evaporation from the soil surface, suppress weeds and/or add nutrients and organic matter to the topsoil. Where Nitrogen is required for crop production, nitrogen fixing plants might be the components of the hedge rows. The primary purpose of alley cropping is to maintain or increase crop yields by improvement of the soil and microclimate and weed control. Farmers may also obtain tree products from the hedgerows including fuel wood, building poles, medicine and fodder and on slopping lands, the hedgerow and prunings may help to control erosion.

Environmental/climate risk to be addressed: Alley cropping usually works best in places where people feel a need to intensify crop production but face soil fertility problems. In addition, enhance wildlife and improve water quality.

Scale to be used: Alley cropping/hedgerow intercropping can be used at plot/ farm or landscape scales

Land use type and Agroecology: The main land use type for Alley cropping practice is cultivated land. Depending on the type of tree species, this practice is applicable to most of agroecology including Moist Dega, Wet Dega, Moist Weyna Dega, Wet Weyna Dega, Moist Kolla, Wet Kolla and Moist berha

Limitation: free grazing, low survival of trees due to moisture stress in dry olla agroecology, harbour rodents and birds

Alley cropping /hedgerow/ in Gimbo woreda (South West Ethiopia), photo credit by Solomon

Alley cropping /hedgerow in Bibugn woreda (Amhara region), photo credit by Negesse

46. Multistory coffee system

Short description: Multistory coffee system/ are intended for the cultivation of coffee mainly and thought of as provider of cash; they include other naturally grown and/or planted species in various strata, often intended for shade and productive functions..

Environmental/climate risk to be addressed: Major environmental and climate risk to be addressed include income shortage, soil fertility depletion, soil erosion, soil moisture stress, low agricultural productivity

Scale to be used: plot/farm and landscape scale

Land use and agroecology: The technology is suitable for sites that are usually the homesteads or fields located close to the homesteads to protect fruits and other produce. The system works in various agroecology with annual rainfall of > 600 mm and it can also grow in irrigated agriculture

Limitation: Multistory coffee system/coffee based Agro-forestry system is difficult to apply under 600mm rainfall unless supported by irrigation. Free grazing is a also the main limiting factor to adopt the technology in the outfield.

Multistory coffee system in Wonsho woreda (Sidama region), photo by Sisay

Multistory coffee system in Sigmo woreda (Oromia region), photo credit by Girum Kebede

47. Vetiver grass strip

Short description: Vetiver grass (*Chrysopogon zizanioides*) is a deep rooted and densely tufted bunch grass which can be easily established in both tropics and temperate regions of the world. Vetiver grass is placed as a strips on or near the edge of a field, across the slope. It plays a vital role in watershed protection by slowing down and spreading runoff harmlessly on the farmland, recharging ground water, reducing siltation of drainage systems and water bodies, reducing agro-chemicals loading into water bodies and for rehabilitation of degraded soils

Environmental and climatic risk to be addressed: Soil erosion, excessive runoff, soil nutrient loss, prolusion,

*Scale to be implemented: plot/farm and l*andscape scale

Land use and Agroecology: Applicable in a broad range of land uses, particularly in cultivated, grazing and forest lands with some level of free grazing. Vetiver grows well in a wide range of agroecologies including all dega, all weyna dega, all kola and moist Berha

Limitations: It is not suitable in area with free grazing, rodents and birds are limiting factors of crop production in the surrounding areas

Vetevar grass strip in Haru woreda (Oromia region), photo credit by Leta Hayilu

48. Homegarden Agroforestry

Description: Homegardens is an ancient and common practice in Ethiopia that consist of three main layers such as herbaceous layers near the ground, a tree layer at upper levels, and intermediate layers in between. The compositions of crops grown in homegardens can be grouped based on function as ornamental, fruits, food crops, vegetables, medicinal, spices and fodder, building materials and fuel woods.

Environmental and climatic risk to be addressed: Soil erosion, soil fertility reduction, excessive runoff, biodiversity loss, deforestation, income, productivity

Scale to be implemented: plot/farm and landscape scales

Land use and agroecology: Homestead development is applicable to most of the agro ecological zones. Particularly more feasible in areas where the moisture conditions are optimal and soil organic matter management can be deliberately and sustainably optimized. Thus, it is applicable more in high rainfall areas, and in moisture stress areas with supplementary irrigation.

Limitations: water shortage for irrigation

Homegarden agroforestry in Adulala (Oromia region), photo credit by Abera Assefa

Fruit based and homegarden agroforestry in Konso special woreda, photo credit by Zenebe Adimassu

49. Hedgerow of shrubs/grasses

Description: Hedgerows can be defined as narrow rows of dense vegetation with sufficient height above the ground. Hedgerow can be formed from grasses or shrubs. Therefore, hedgerows can be called: hedgerows of grasses, hedgerows of shrubs/trees, or specifically, hedgerows of Leucaena, hedgerows of Sesbania, hedgerows of Vetiver grass, etc.

Environmental and climatic risk to be addressed: Soil erosion, excessive surface runoff, water shortage, GHG emissions

Scale to be implemented: Landscape scale and plot/farm scales

Land use and Agroecology: Hedge rows can be applied in cultivated lands, grazing lands and forest lands. The establishment of the species and effective performance of the hedgerows is expected in areas receiving adequate amount of rainfall (more than 800mm. The practice can be adopted in a wide range of agroecologies depending of the suitability of grasses and shrubs

Limitations: moisture stress and ree grazing constrain the adoption of hedgerows

Vetiver grass hedgerows in Haru woreda (Oromia region), photo credit by Leta Hayilu

Hedgerow in Gimbo woreda (Southwest Ethiopia region), photo credit by Addesse Ago

50. Exclosure

Short description: Exclosure (sometimes called area closure) is an area from which intruders (such as browsing animals) are excluded by fencing or other means the exclosure plot is used to keep an area in a natural condition, free from grazing by livestock. Exclosure is a land restoration approach and practice where the degraded land is rehabilitated and restored its productivity. The experience of exclosure management in Ethiopia is mainly at a large scale for rehabilitating the degraded hillsides and highlands where land degradation has become pervasive due to extensive agricultural practice for long periods.

Environmental/climate risk to be addressed: Restore hydrological balance, increase biomass productivity, stabilize degraded ecosystems and minimize the shortage of land.

Scale to be used: exclosure can be practiced and applicable at the landscape level.

Suitable land use type and agroecology: Area closure can be practiced or implemented in degraded lands. The lands considered for exclosure are those lands that lost productivity for cultivation or grazing, often known as communal lands and characterized by loss of fertility, depletion of vegetation cover. It is is a landscape-level practice suitable for rehabilitating degraded lands in most agroecological zones with certain modifications in terms of its management and participation of communities.

Limitations: Exclosure requires community mobilization and collective action, competes grazing land for livestock

Exclosure with *acacia decurence* in Wogera Woreda (Amhara region), photo credit by Yaregal Fiseha

Exclosure in Lume woreda (Oromia region), photo credit by Mohammed Rabo

51. Re-vegetation through enrichment plantation

Short description: Re-vegetation through enrichment plantation practices are applied to degraded lands intention to restore the lost productivity; biomass, biodiversity and vegetation cover following plantation. The re-vegetation and/or enrichment plantation stabilizes the physical soil conservation structures, stabilize degraded/fragile lands, restores and increases the biomass, biodiversity, vegetation cover and the productivity of degraded lands. These measures are made of various vegetation; predominantly trees, shrubs, grasses and herbaceous legumes applied in combination or various soil and moisture conservation measures..

Environmental and climate risk issues to be addressed: Soil erosion, excessive surface runoff, loss of biodiversity, deforestation, GHG emissions

Scale to be implemented: It may be applied at farm and landscape scales

Land use and Agroecology: The technology is more appropriate for areas receiving sufficient amount of rainfall for reliable establishment and survival of the vegetation. Especially Dega and Weine Dega agro ecological zones where the amount of rainfall is sufficient and evapotranspiration is relatively low the intervention is very relevant and effective. The technology could also be applicable to dry areas where systematic in-situ moisture conservation practiced.

Limitations: One of the major limitations in the re-vegetation and enrichment plantation of degraded lands is the long gestation period of benefiting land users resulted from slow rates of recovery.

Revegetation enrichment plantation on degraded land in Wegera woreda (Amhara region), photo credit by Yaregal Feseha

Re-vegetation through enrichment plantation in Ura woreda (Benishangul Gumuz region), photo credit by Workye

Revegitation enrichment plantation in Nedhi-Gibe woreda (Oromia region), photo credit by Zelalem Lemi

52. Grass strips along the contours

Short description: Grass strips are vegetative barriers made of grass planted in narrow strips of 0.5 to 1 meters width laid out along the contour. Grass strips are known to be more effective in controlling soil loss than water compared to the physical structures, because while soil particles are filtered out and left behind or within the strip, the water gradually passes through the grass strips. Grass strips control erosion rather effectively in gentle slopes but above 5-8% slope their effectiveness decreases.

Environmental and climatic risk issues to be addressed: Soil erosion, excessive runoff, fertility depletion, water quality deterioration

Scale to be implemented: Applicable at both landscape and plot/farm scales

Land use and Agroecology: Grass strips are applicable in most of agro ecological zones where the amount of rainfall allows the establishment of dense grass strips. The potential for establishing effective grass strips is higher in medium to high rain fall areas. Grass strips are most feasible in warm and moist areas and less suitable for cooler and drier areas where the growth of the grass is limited by climatic conditions.

Limitations: They are less effective in controlling the loss of water as they provide little storage capacity. Also may not offer much resistance against erosive rainstorms, particularly during the early stage of establishment as the new shoots are not yet well developed.

Grass strip along the contour in Anstokiya-Gemza woreda (region), photo credit by Mekitew

Grass strip along contour in Machakel Woreda (Amhara region), photo credit by Teshome Wollie

53. Contour planting

Short description: Contour planting is a conservation practice where the land ploughing and planting of crops along the contour line. Contour planting is a farming system with row planting that is applicable on moderately short slopes with fairly stable soils. In Ethiopia, contour planting is typical of the Harege highlands.

Environmental/climate risk to be addressed: Conserve moisture, increase productivity and improve soil fertility

Scale to be used: Contour planting can be used at the farm/plot level

Suitable land use type and agroecology: Contour planting can be practiced in different land use types such as cultivated land, degraded/ grazing land to cultivated land. Contour planting is suitable mainly in moisture-stress areas that conserve moisture for crops and can be used as a soil conservation practice. The contour planting needs to be graded in high rainfall areas, which helps to drain water from the cultivation land

Limitations: Keeping contour using oxen plow is difficult

Contour planting in Omonada woreda (Oromia region), photo credit by Girma Kebede

54. Strip cropping

Short description: Strip cropping is **a method of farming that involves the alternation of close strip crops such as maize, soybeans, etc with small grains such as barley and wheat.** In strip cropping, two or more than two crop strips are accepted on a contour. Strip cropping can also be accepted more than one crop in an alternate strip system by following the contour pattern mainly to control soil erosion, improve soil fertility and control plant disease/pest.

Environmental/climate risk to be addressed: crop productivity, control soil erosion, soil fertility depletion, plant disease/pest.

Scale to be used: Strip cropping can be used at the farm, plot, and landscape levels.

Suitable land use type and agroecology: Strip cropping can be applied to most agro-ecological zones with gentle slopes, especially in areas where crops grow, such as maize and sorghum.

Limitations: free grazing of livestock affects the survival and growth rates of grasses.

Strip cropping in Oromia at Tiro afeta woreda by Zelalem Lemi

Grass strip cropping in Amhara at Antsokia Gamza woreda by Mekitew

Grass strip cropping in Amhara at Antsokia Gamza woreda by Teshome Wollie

55. Enset-based agroforestry system

Short description: Ensete (*Ensete ventricosum*), sometimes called "false banana," is a leafy plant 6-12 meters tall, with a swollen false stem (or pseudo-stem) formed by the leaf bases. The large leaves grow in spirals, each one to 6 meters long and 1 meter wide, bright green with a thick pink-red midrib and short red stalk. Enset-based agroforestry is a conservation practice where the planting of enset plants (*Ensete ventricosum*) helps make the land productive. In Ethiopia, the Enset-based agroforestry mainly grows in southern and south western parts.

Environmental/climate risk to be addressed: Reduce temperature, provide shade, increase household income, and improve soil fertility and productivity.

Scale to be used: Enset-based agroforestry be used at plot/ farm or landscape scale.

Land use and agroecology: Enset-based agroforestry is suitable for agroforestry around homestead and beyond. Enset-based agroforestry is grown in sub-humid and semi-arid agro-ecological zones with rainfall above 600mm areas.

Limitations: limited technology for enset preparation

Enset based agroforestry in Oromia at Omonada woreda by Girma Kibret

Enset based agroforestry in SNNP, Lemu Wereda by Zenebe Adimassu

IV. SLM/CSA practices/approaches related to water management

56 Water harvesting trenches/pits for trees, fruits, shrubs or grass

Short description: Water harvesting trenches are large and deep pits constructed along the contours with the main purpose of collecting & storing rainfall water to support the growth of trees, shrubs, cash crops and grass or various combinations of those species in moisture stressed areas. Trenches can have flexibe to accommodate the requirements of different species. Trenches collect and store considerable amount of runoff water, thus vegetation grows faster and vigorous. Trenches protect cultivated fields located downstream from flood and erosion, since part of the water captured by the trenches reaches the underground aquifer. As a result, water tables are recharged and supply springs and wells with good quality water and for a long period of time

Environmental/Climate risk to be addressed: land degradation, moisture stress, soil erosion, feed shortage, income, flood, water shortage.

Scale to be implemented: The technology can be implemented in plot level and landscape level or both. However, it is more effective at landscape scale.

Land use and agroecology: Applicable in steep and degraded hillsides (max slope 100%) and for community closures. Can be combined with other measures such as hillside terraces, stone bunds and exclosure. The practices is suitable in dry agroecology including Dry Dega, Moist Dega, dry Weyna Dega, Moist Weyna Dega, Dry Kolla and Wet Kolla

Limitation: Malaria infestation in maralia prone areas

Water collection trech in Amhara, MenzMama woreda, by Haylegnaw Abebe

Deep trench with planting pit in Oromia at Lalo kile woreda by Bedhassa Fetene

57. Community ponds

Short description: Community ponds are small pond or reservoir like constructions greater size of household level pond but the construction is able by the community and constructed for the purpose of storing the surface runoff, generated from the catchment area. The community pond is used for livestock watering and other purpose depending on the water insecurity problem of the area.

Environmental/climate risk to be addressed: water shortage for demotic and agricultural purposes

Scale to be used: community, landscape scales

Land use type and agroecology: The technology can be applied in grass and communal land with flat to gentle slopes. Suitable in areas where there are no surface and underground water resources. Mostly suitable arid and semiarid areas where water scarcity is an issue. Hence most recommended agroecologies for community pond development include dry Dega, Dry Weyna Dega, Dry Kolla, Moist Kolla and Berha.

Limitations: Insufficient rainfall in dry areas, sedimentation, evaporation, seepage, needs for collective action, free ridding of water resources

Community pond in Amhara at Sinan woreda by Chilot Yitages

Community pond in Amhara at Sayint woreda by Bamlaku Adane

58. Deep percolation pit

Short description: A percolation pit is a structure, constructed on any marginal land with perviouos soil to recharge ground water, reduce flooding and runoff.

Environmental/Climate risk to be addressed: Soil erosion, excessive surface runoff, water scarcity, flooding

Scale to be implemented: appropriate at landscape scale

*Land use and agroecology: It is s*uitable in all areas where there is no drainage problem or where the ground water table is deep. It can be constructed in any ecology with sufficient runoff to recharge ground water.

Limitations: Percolation pits shall not be excavated under the following conditions: 1) Little or no runoff 2) Weathered limestone/alkaline soils - as it would increase pH of the water; 3) Catchment with high concentration of manure or animal wastes - as it would increase the nitrate content of the groundwater; 4) Clay or impermeable geological formation - as it does not allow fast percolation of water

Deep percolation pit in Amhara at Takusa wored, photo credit by Angaw Zewdu

59. Percolation pond

Short description: A percolation pond is a structure, constructed on any marginal land with pervious soil, to recharge the ground water; to enhance biomass production through improved water availability in the soil profile; to reduce runoff and subsequently erosion and land degradation.

Environmental and climatic risk to be addressed: Soil erosion, excessive surface runoff, water scarcity, flooding, GHG emissions

Scale to be implemented: most appropriate at landscape scale

Land use and agroecology: Suitable in all areas where there is no drainage problem or where the ground water table is deep. Suitable in areas where the ground is pervious can be constructed on any topography with adequate runoff. It should be considered only as an element of an integrated watershed development.

Limitations: Percolation ponds shall not be excavated under the following conditions: i) Little or no runoff ii) Weathered limestone/alkaline soils; iii) Catchment with high concentration of manure or animal wastes - as it would increase the nitrate content of the groundwater; iv) Close to deep gorges - as the recharged water becomes easily unavailable

Percolation pond in Bebasona woreda (Amhara region), photo credit by Anteneh

Percolation pond in Kersa woreda (Oromia region), photo credit by Adinan Mohamed

60. Rainwater storage cisterns/tanks

Description: Cisterns/tank are ex-situ types and are defined as structures constructed artificially using different construction materials including masonry or the soil itself either above or below the ground surface for the purpose of rainwater storage. Cisterns/tank, may store water collected from ground surfaces, from rooftops, green houses, or from any permanent or seasonal water sources. The stored water can be used for irrigating crops (supplementary, complete irrigation or both) and water supply for livestock and humans. Any combination of these Cisterns in which their storage capacity is ranging from 10 to 100m^3.

Environmental/climatic risk to be addressed: Water scarcity

Scale to be implemented: household, community

Land use and agroecology: Rainwater harvesting cisterns can be used in all Ethiopian agroecology where water is a major problem.

*Limitations: high cost of construction, i*nsufficient rainfall in dry areas, evaporation, seepage and free ridding of water resources

Rainwater storage tank in Adulala (Oromia region), photo credit by Abera Assefa

61. Hand dug wells

Short description: Hand-dug well, as the name implies, are excavated wells, and the digging (excavation) is done by human labour. Hand-dug -wells for communities or schools are lined or use concrete tubes (Caisson sinking). In this case, hand-dug wells where the surface area is covered and the upper part of the well shaft above the water level is water tight sealed and protected from any runoff or dirt entering the well.

Environmental and climatic risk to be addressed: Water scarcity

Scale to be implemented: Household and/or community scale

Land use and agroecology: The site selection should be done by a team which needs to include the community and school administration and a suitable qualified water engineer or hydrologist.

Limitations: requires digging equipment, the sides of an unlined well may collapse when wet if adequate slope is not provided.

Hand dug well in Burezuria woreda (Amhara region), photo credit by Melisew Mengistu

62. Pond fish culture

Short description: Pond fish culture is a method that water is maintained in an enclosed area by artificially constructed ponds where the aquatic animals such finfish and shellfish are reared. The ponds may be filled with canal water, rain water, and bore well water or from other water sources.

Environmental/climatic risk to be addressed: food security and poverty

Scale to be implemented: community scale

Land use and agroecology: Pond fish culture can be promoted in most of the agro ecological zones and the variability may exist for the type of fish to be practiced in different agro ecological zones. However, it is best to position the fishpond in a place sheltered from wind. The advantage is to slow down temperature drop when there is strong wind during winter.

Limitations: Limited information, knowledge and skill are available and also acquiring the fingerlings (baby fish) is not easy. Market outlet is another limiting factor for the promotion of the practice.

Plot scale

Pond fish culture in Homosha woreda, Benishangul Gumuz region photo by by Gebrehiywot

Pond fish culture in Gumay woreda, Oromia region photo by Endale Geta

63. Backyard water harvesting pond

Short description: Ponds constructed around the homestead and can be constructed and used at household level. Such ponds can collect water from ground catchment and/or roofs. The ponds can be unlined, lined with black polyethylene membrane or masonry. The size varies based on the availability of runoff and capacity of farmers to invest in pond construction. The water can be used for irrigation and/or domestic consumption mainly for livestock.

Environmental/climatic risk to be addressed: Water shortage for irrigation and domestic use

Scale to be implemented: plot/farm and household scale

Land use and agroecology: Mainly in the cultivated homestead. It can be applied in various agroecology with water shortage.

Limitations: Malaria in malaria prone areas, seepage, evaporation, constriction cost

Backyard water harvesting pond in Lemo Wereda, SNNP region photo by Zenebe Adimassu

64. Roof water harvesting

Short description: Rooftop rainwater harvesting is a structure that is used for rainwater collection from the roof, and the structure is constructed with corrugated or metal sheets. Thus, rooftop rainwater harvesting structures can also be collected from the roofing of waterproof materials that don't have hazardous chemicals to the water supply for livestock, domestic and agricultural production use. The rooftop rainwater harvesting can be stored and transported by the proper conveyance structure both using below and above structures. The basic components rooftop rainwater harvesting system include roof catchment, conveyance (downpipe and gutter) and storage

Environmental/climate risk to be addressed: water shortage for demotic and agricultural use

Scale to be used: plot/farm scale and household level.

Suitable land use type and agroecology: Suitable in most land use types at plot and farm levels. In Ethiopia, rooftop water harvesting can be implemented in all agro-ecological zones. It is more feasible in semi-arid and arid agro-ecology where the surface and groundwater access is limited.

Limitations: high cost for storage and conveyance

Roof water harvesting in Tigray at Kolla Temben by Mulu Haftu

Roof water harvesting in Tigray at Degua Temben by Gedyan Tesfay

65. Spring development

Short description: Spring development is a conservation structure where a spring or seep water reaches the surface from an underground supply with the appearance of a smell of water holes or wet spots along the river banks or as a wet spot on the hillsides. The spring development can be formed from spring water flow, and the seeps may come from small porous ground openings, fissures in solid rock, or joints.

Environmental/climate risk to be addressed: Spring development helps to protect spring water sources which are useful for domestic water supply and livestock.

Scale to be used: Spring development can be used at community level and landscape scale.

Suitable land use type and agroecology: Spring development should preferably be implemented in communal lands to avoid conflict between the community and land user. Spring development can be implemented in most agro-ecological zones where water is a problem and potential for spring development.

Limitation: contamination due to fertilizer use in the upstream part of the spring

Spring development for human and livestock use in Oromia at Ambo woreda by Adugna Mirgisa

Spring box development in Benishangul at Homosha woreda by Dereje Cherinet

V. Other related CSA practices/approaches

66. Energy saving stove (ESS)

Short description: Rural energy in Ethiopia entirely depends on biomass energy from wood, cow dung and crop residue using traditional open stoves, which are low in energy efficiency utilization and are apparently the major cause of deforestation. Hence the use of energy saving cooking stoves reduces fuelwood consumption of households and hence reduces deforestation/greenhouse gas emission. The technologies vary – from the basic mud stove to factory manufactured metal stoves. Some of the various types of ESS products promoted in Ethiopia ainclude *Tikikil, Lackech, Mirt and Gozie*.

Environmental/climate risk to be addressed: deforestation, wood shortage, greenhouse gas emission

Scale to be used: household and community levels

Land use type and agroecology: the technology can be applicable to the rural and urban community in all agro-ecology, at HH level as well as community levels government/project.

Limitations: Limitation of the promotional approaches for the required behavioral change financial sources to purchase stoves

Mirt-energy saving stove Jogo watershed (Oromia region), photo credit by Abera Assefa

Energy saving stove preparation in Bibugn woredby (Amhara region), photo credit by Negesse Munie

67. Beekeeping/apiculture in exclosure

Short description: Beekeeping/apiculture is the care and management of honey bees for the production of honey and wax. Beekeeping in the exclosure areas is a CSA practice where bees are managed youth and landless groups to support their livelihoods. Bees also play an excellent role in pollination which help in increasing the yield of several crops. Since exclosures are protected areas with various flowering trees and grasses, honey productivity of beehives is high compared to beehives managed in the homestead.

Environmental/climatic risk to be addressed: food security, unemployment, low income, loss of biodiversity

Scale to be implemented: community level

Land use and agroecology: This practices is implemented in exclosure at various agroecologies

Limitation: damage by insects, theft

Beekeeping in exclosure in Gumay yachi kereyu woreda, (Oromia region), photo credit by Asaye Tafese

Beekeeping in exclosure for youth in Ura woreda (Benishangul Gumuz region), photo credit by Workye

68. Diffused Light Store (DLS)

Short description: A Diffused Light Store (DLS) is a low-cost seed potato storage technology made from locally available materials. The concept of a DLS involves storing seed potato in a natural, diffused light (indirect sunlight) structure with good ventilation. Tubers are stored in shelves, trays or crates up to three layers deep. DLS technology has made it possible to store seed potato upto 4 months, thus suitable for bimodal and extended rains farming systems.

Environmental/climatic risk to be addressed: Seed shortage, post harvest loss

Scale to be used: household, community levels

Land use and agroecology: This technology is constructed around homestead areas of individual households or communal lands. The technology is suitable in most dega agroecology including all High Dega, Dry Dega, Wet Dega, Moist Dega, Dry Weyina Dega, Wet Weyna Dega, Moist Weyna Dega,

Limitations: Not effective in dry areas

Diffused Light Store (DLS) in Lemo Woreda (SNNP Region), photo credit by Zenebe Adimassu

69. Rehabilitation of grazing lands

Short description: Rehabilitation and conservation of grazing lands refers to the application of appropriate packages to the grazing lands lost productivity or having sub-optimal productivity to control the accelerated soil erosion and to increase their productivity. An area of heavily degraded grazing land that was rehabilitated by establishing eyebrow pits to control and harvest runoff, planting trees and grasses, and fencing the site to control grazing. The main purpose is to re-establish vegetative cover on the almost bare and overgrazed site.

Environmental/climate risk to be addressed: feed shortage, grazing land degradation.

Land use and agroecology: The technology is much more effective for pastureland/grazing land use system. Grazing land management measures are applicable to all agro climatic zones with some modifications in the approach, technologies and species selected. In areas receiving high rainfall, the potential for increasing biomass production and vegetation cover is much higher than areas receiving low rainfall and moisture stress areas.

Limitation: requires collective action

Grazing land improvement using cut-and-carry approach in Machakel Woreda (Amhara region), photo credit by Worku

Grazing land rehabilitated by biological intervention in Gumer woreda (SNNPR), photo credit by Tilahun

70. Linking fattening with exclosure

Short description: Small-ruminant fattening linked with exclosure is a CSA practice used to build food security and improve farmers' livelihoods. It is an easy way of getting income from exlosure areas using cut-and-carry system. The system also avoids free grazing and reduces land degradation.

Environmental/climate risk to be addressed: income shortage, feed shortage, land degradation

Scale to be used: Small ruminant fattening linked with exclosure can be used at a farm or household levels

Land use and agroecology: The practice is suitable in exclosure and grazing lands. The practice also applicable in most agro-ecological zones where there are exclosures with good feed supply and productive small ruminant.

Limitation: Insufficient feed in the exclosure, market outlet

Sheep fattening in Uraga woreda (Oromia region), photo credit by Andualem Tekle

Livestock fattening in Semen Mecha woreda (Amhara region), photo credit by Fetene Mekonen

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