Soil moisture conservation techniques

Challenge: Too little water

Adaptation response: Water storage

Description

The main objective of soil moisture conservation is to minimize the amount of water lost from the soils through evaporation (water loss directly from the soil) and transpiration (water loss occurring through the plants) – or combined, the evapotranspiration. Preserving soil moisture is important means to maintain the necessary water for agricultural production, and also helps minimize irrigation needs of the crops. This is especially important in areas where rainwater and/or groundwater resources for irrigation are scarce or decreasing due to climate change or other causes.

Implementation

There is a variety of methods that can be used to conserve soil moisture. Most of these are relatively low cost and complexity approaches, primarily relying on the presence of required materials and technical capacity locally. Many of the methods rely on providing some kind of cover for the soil to minimize evapotranspiration and direct soil exposure to heat and sun. Generally, most methods used for soil quality improvement and conservation, will also yield benefits to soil moisture conservation.

Examples of methods for reducing excess soil moisture loss include following:

- Spreading manure or compost over the soil – this minimizes evapotranspiration and also provides valuable nutrients to the soil through processes of decomposition

- Mulching – mulch is a layer of organic (or inorganic) material that is placed on the root zone of the plants. Examples of mulch materials include straw, wood chips, peat. Inorganic mulch in form of plastic sheeting is also used. Mulching is most suited for low to medium rainfall areas, and less suited for areas with very wet conditions.

- Conservation tillage – reducing or, in extreme cases, completely eliminating the tillage to maintain healthy soil organic levels which increases the soils capacity to absorb and retain water. Conservation tillage is a specific type of such approach where crop residue is left on the soil to reduce evapotranspiration, and protect soil surface from wind, sun and heavy rain impacts.

- Crop rotation – growing different types of crops every season helps improve soil structure and thus water holding capacity. Examples include rotating deep-rooted and shallow rooted crops that make use of previously unused soil moisture, as plants draw water from different depth levels within the soil. Crop rotation may also improve soil fertility and help control pests and diseases.

- Green manuring – growing of plant materials with the sole purpose of adding to the soil for improved organic matter and nutrients. The improved soil quality then also improves water retention capacity.

- Deep tillage – suited for some areas and soils, deep tillage can help increase porosity and permeability of the soil to increase its water absorption capacity.

- Mixed cropping and interplanting - cultivating a combination of crops with different planting times and different length of growth periods.

- Contour ploughing – by ploughing the soil along the contour instead of up- and downward slopes, the velocity of runoff is reduced, creating even barriers, and more water is retained in the soils and distributed more equally across the cropland.

- Strip cropping - growing erosion permitting crops and erosion resisting crops in alternate strips.

Other soil moisture conservation techniques may include rainwater harvesting to minimize runoff and collect water for use on site. For more technologies on this see technology sheet *Rainwater harvesting for infiltration.*

Environmental Benefits

- The benefits of many soil conservation methods, depending on the material used, may also include better control of weeds, provision of additional nutrients to the soil, soil temperature control and protection of soil surface from the impacts of heavy rain and wind.

- Active reuse of waste organic materials also reduces waste management needs, returning the residue crops and plants to the soil through decomposition.

Socioeconomic Benefits

- Potential to reduce water irrigation needs, increase crop productivity and improve soil quality
- By extension, reduced irrigation needs may also reduce the costs and energy requirements of water pumping for irrigation.

Opportunities and Barriers

Opportunities:

- Improved soil moisture goes hand in hand with improved soil quality thus potentially improving harvest and reducing soil degradation
- Opportunities for using existing waste materials may considerably reduce costs and needs for waste handling
- Many soil conservation methods are relatively low cost and complexity approaches, primarily relying on the presence of required materials and technical capacity locally
- May create new income and synergies between different crop variety farmers (e.g. using palm oil production residues for mulching).

Barriers:

- In some settings crop residues are not necessarily 'residues', and may already be used for animal fodder, thus necessitating additional investment for soil conservation purposes
- Planting of new cycle of crops through mulch or other crop residues may be difficult for non-mechanized agriculture, thus may not be suited in all locations.

Implementation considerations*

Technological maturity:	4-5
Initial investment:	1-4
Operational costs:	2-3
Implementation timeframe:	1-3

* This adaptation technology brief includes a general assessment of four dimensions relating to implementation of the technology. It represents an indicative assessment scale of 1-5 as follows:
Technological maturity: 1 - in early stages of research and development, to 5 – fully mature and widely used
Initial investment: 1 – very low cost, to 5 – very high cost investment needed to implement technology
Operational costs: 1 – very low/no cost, to 5 – very high costs of operation and maintenance
Implementation timeframe: 1 – very quick to implement and reach desired capacity, to 5 – significant time investments needed to establish and/or reach full capacity
This assessment is to be used as an indication only and is to be seen as relative to the other technologies included in this guide. More specific costs and timelines are to be identified as relevant for the specific technology and geography.

Sources and further information

Agriiinfo, 2015: Soil And Water Conservation Methods - Management Practices, http://www.agriinfo.in/?page=topic&superid=1&topicid=436

FAO, 2003: Conservation Agriculture for Soil Moisture, Briefing Notes - Production Systems Management, http://www.fao.org/ag/ca/doc/BN_soil_moisture_LR.pdf

Hudson, N.W., 1987: Soil and Water Conservation in Semi-Arid Areas, Issue 57, Volume 57 of Fao Soils Bulletin, Soil and water conservation in semi-arid areas, Food and Agriculture Organization of the United Nations, 1987, http://www.fao.org/docrep/t0321e/t0321e-10.htm#TopOfPage

Namirembe, S., Nzyoka J.M. & Gathenya, J.M. 2015. A guide for selecting the right soil and water conservation practices for small holder farming in Africa. ICRAF Technical manual No.24. Nairobi, Kenya: World Agroforestry Centre (ICRAF).

Nova Scotia Federation of Agriculture (NSCA), 2011: Soil Moisture Conservation Factsheet, www.nsfa-fane.ca/efp/wp-content/.../NSCA-2001-Soil-Moisture-Conservation.pdf