Contour Bunds for Water Harvesting

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Summary

Availability of water is one of the main constraints to dryland agriculture, and recent declines in rainfall and changes of precipitation patterns caused by climate change severely jeopardize food security. To enhance yields and resilience of crops across Africa's semi-arid areas, it is of major importance that soils intercept maximum available rainwater, and that surface runoff is minimized. Contour Bunding Technique (CBT) involves short walls that are arranged in specific patterns along the field contour, creating micro-catchments. Bund structures intercept runoff and increase rainfall capture, water storage, and deep infiltration, and reduce soil erosion and gully formation. Planting trees on top of the bunds permanently marks and reinforce them, help to improve soil fertility, and can provide quality forage for animal feed when using agroforestry species that have high fodder yield and nutritive value. CBT keeps the soil moist for longer which extend the window for field preparation and planting by 7-10 days. The harvesting of water results into higher grain yield of sorghum and millet, and substantially reduces soil erosion.

Technical Description

A majority of soils across African drylands do not effectively store rainwater for crops and too often exhibit high levels of surface runoff and soil erosion. Constructing sequences of parallel bunds along the soil contour lines of farmland allows capture of water and creates slow infiltration areas and safer drainage of excess runoff. Some bunds have a parabolic shape, so rainwater is distributed toward the center. Soil inside the bunds must be evenly levelled, otherwise water will stagnate at the lowest point and damage crops. Planting trees on top of bunds or perpendicular ties extends the performance of the CBT and its benefits for crop production and better resists the heavy downpours that could otherwise wash away the water harvesting structures.

Uses

Applying CBT is most pertinent in farming systems of the semi-arid drylands but is also suitable for wetter areas. In places or seasons with low rainfall, CBT helps to harvest water and increase availability of moisture for crops. In places or seasons with high rainfall, CBT helps to reduce the runoff and erosion, and risks of flooding downstream. Two types of micro-catchment structures exist, contour bunds (or contour ridges) and semi-circular bunds, and the choice between these depends upon topography and socio-

cultural contexts. Installing and maintaining contour bunds is most effective at larger scale through coordinated action among neighboring farmers. Semi-circular bunds can be used at smaller scale for individual fields and are staggered along the contour lines of fields with the bow pointing down the slope. The space between bunds depends on the topography of a field, the steeper the slope, the closer together the contour bunds. Contour bunds are appropriate for terrains with a low uniform slope (<5%) and gentle, even runoff. Semi-circular bunds are used on fields that have a higher slope (>5%) and uneven surface where runoff flows are strong and irregular.

Composition

Where rock material is abundantly available, bunds can be reinforced with stone, making them more stable and requiring less maintenance. Where rock material is limited, bunds can be made of soil ridges that usually require annual maintenance. The correct placement of CBT is critical and lines of equal elevation within a field can be identified by a technician using a laser level tripod, or a farmer with an A-frame or water/spirit level. Demarcating the contours requires about 50 stakes per hectare. Ridges may also be formed using draught animals. A range of fast-growing agroforestry species can be planted on top of soil bunds as reinforcement, the most common ones being nitrogen-fixing forage trees such as gliricidia and leucaena.

Means of application

The first step of installing bunds is a joint field visit by farmers and an experienced technician to understand the direction of slopes, the movement of water, farmer’s practices, community bylaws and relationships between neighbors. In this way, unwanted water drainage is avoided and synergies for collaboration are created. The second step is to identify contour lines with land surveying tools and demarcate this with temporary markers. Next, bunds can be constructed by hand or with an ox-drawn plough. Three or four passes of a plow are needed for heaping soil to form a sufficiently tall bund (e.g., 50-80 cm). The standard distance between bunds is 50 m if the slope is less than 1.6% and is 20-30 m when the slope is between 1.6% and 5%. Seedlings of fast-growing trees to reinforce bund may be planted at a spacing of 3 meters on the crest. Bunds made of soil need to be regularly maintained and strengthened using a plough or hand hoe.

Agroecologies	Dryland area, Moist savanna.
Regions	Africa South of Sahara.
Developed in Countries	Burkina Faso, Chad, Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Available in	Burkina Faso, Chad, Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.

Solution Forms	Management.
Solution Applications	Soil/land conservation.
Agricultural Commodities	Sorghum/Millet.
Target Beneficiaries	Women, Youth, Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

The following preconditions must be fulfilled to realize widespread deployment of CBT: 1) Awareness raising about the advantages of engineered micro-catchments for crop production, soil fertility improvement and watershed management, 2) Training of extension agents and farmers in the use of the land surveying equipment and methods for constructing bunds that reduce investment costs, 3) Consultation between neighboring farmers to understand water movement across the landscape and determine the best placement of bund structures, and 4) Access to animal-drawn or motorized plough, low-cost stone resources, and seedlings of fast-growing trees for building and reinforcing bunds.

Production Costs

Land surveys for drawing the contour lines in the field cost about US $9 per hectare. The work to move earth or stones represents the largest cost of CBT, with labor requirements varying between 30 to 120 person days per hectare for different types and dimensions of bunds. If animal-drawn or motorized ploughing equipment is available, the construction time and workload reduces substantially, but costs may rise when machinery must be hired or maintained. Seedlings from fast-growing trees must be purchased, or farmers need to establish their own nurseries, incurring costs for labor and materials. Training extension agents and farmers on methods for CBT requires considerable investment from national or non-governmental programs to provide training and information materials.

Customer Segmentation

Small-scale and commercial farmers, as well as local authorities involved with agricultural development and water management, are the main target groups of CBT.

Land surveyors, tractor owners and nursery keepers are involved in scaling as commercial entities.

Potential Profitability

Engineering micro-catchment structures on farmland offers multiple benefits for crop production, environmental protection, economic livelihoods, and social welfare. In Mali, grain and straw yields of sorghum for CBT plots were three time higher compared to lands without CBT. Implementing CBT reduces the amount of runoff by 40%, and decreased sediment loss from erosion by 20%. Planting fast growing trees species on the crest of contour bunds provides shade for crops and regulates temperatures during heatwaves. Up to 100 kg of dry biomass is accumulated in trees on an area of 100 m2, which contributes to fuelwood supply and carbon sequestration.

Licensing Requirements

No official permits are needed for installing bunds on farmlands in most countries. Approval from local authorities or chieftains is best obtained to avoid conflicts and ensure alignment with communal land and watershed management.

Innovation as Public Good

Knowhow about the technology is disseminated as a Public Good by ICRISAT and national agencies.

Solution Images



Recently installed contour bund on a farmer field in Mali



Semi-circular bunds reinforced with stones



Land surveying tools for correct placement of contour bunds:
laser level tripod (left) and A frame (right)

Institutions



Accompanying Solutions

Varieties for Better Nutrition and Stress Resistance

Fertilizer Micro-Dosing to Enhance Yield and Use Efficiency

Dual-purpose Varieties for Crop and Livestock Integration