



Management of On-Farm Soil Erosion using Fanya Juu and Fanya Chini Terracing:

A MANUAL FOR FARMERS

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Acronym

- DAP – Di-ammonium Phosphate
- HI – Horizontal Interval
- SWC – Soil and Water Conservation
- VI – Vertical Interval



WHAT IS SOIL EROSION?

Soil erosion is a process through which water or wind dislodges soil particles, transports and deposit them away from the farm. In tropics (like Kenya), water erosion is the most common and impactful form of erosion.

10

Number of tonnes lost per acre on erosion

The process involves raindrops hitting bare ground and dislodges topsoil¹ particles and washes them away. During erosion, nutrients held on the soil particles are also lost. Erosion affected lands tend to be less fertile and less productive, resulting to reduction in the number of bags of food (grains, tubers and vegetables) a farmer can harvest.

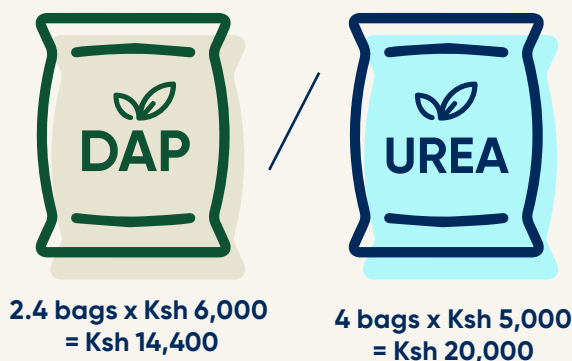
In Kenya, where many farmers extensively cultivate their land with minimal consideration for soil conservation, soil erosion can be a significant challenge. Remember a time when your area experienced heavy rainfall, picture heavy raindrops hitting already loosened soil. Afterward, the disintegrated soil particles are carried away through surface run-off and deposited into other ecosystems like rivers, lakes or seas. Imagine that process happening every season. How would your land look like? See how a land under severe soil-erosion looks like in pictures below.



Soil Erosion Caused Nutrient Loss

Consider this example: In an acre of farmland in Kenya, soil erosion can lead to the loss of around 8 tons of topsoil per year. Now, let us break down the economic impact using a 5% slope of land under maize production. According to studies, such losses will result in nutrient loss equivalent to 2.4 bags of DAP (Diammonium Phosphate) and 4 bags of Urea per acre. Considering the cost of inputs, where one bag of DAP is Ksh 6000 and 1 bag of Urea is Ksh 5000, the economic losses start to add up.

So, in just one acre, the land total economic value loss could rise to upto Ksh 34,400, annually (Ksh 86,000 per hectare). However, it is not just about the economic losses. Soil erosion has broader consequences for the farming system. The loss of topsoil means reduced water retention capacity, poor infiltration, reduced fauna diversity and abundance, and reduced crop nutrient availability. This affects not only the economic aspect but also the overall health and resilience of the farming ecosystem.



Why should you worry about soil erosion?

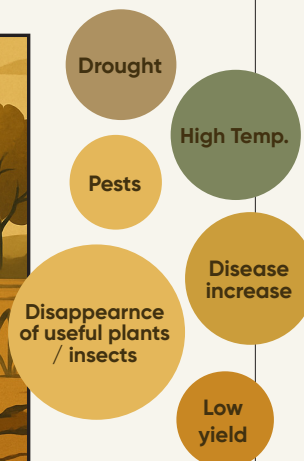
Soil takes a very long time to form (It is estimated that it takes more than 100 years to make 1 inch of soil). And transitioning to farmable soil takes even longer time. Thus allowing soil to be lost compromises our ability as a community and a country to produce adequate food now and makes it harder for our future generations.

Also, during erosion, soil organic carbon is exposed to air and other environmental factors that causes its oxidation, and thereafter released into the atmosphere. This causes the accumulation of greenhouse gases, making the world warmer contributing to climate change. Most of you have realized the changes in rain and temperature patterns resulting to disappearance of beneficial insects and plants.

All these issues then lead to problems like not having enough food and fodder, and increased incidences of difficult to manage pests and diseases. So, taking care of our soil is not just about farms; it is about ensuring we all have enough to eat, stay healthy, and live better lives.



Greenhouse gases accumulation



What can you do to manage Soil Erosion?

To counter on-farm soil erosion, adopt simple and effective practices. Begin by planting cover crops such as grass or legumes to shield the soil from raindrops, particularly during off-seasons. Practice minimum tillage (reduce soil disturbance) such as chisel plowing (preferable for hardsetting dryland soils). Adopt contour plowing on sloping lands, and integrate stone bands or grass/shrubs/tree strips at recommended horizontal intervals (Distances between bands/strips). In a scenario where the land is sloped (>5%), effective prevention and management of soil erosion is through Fanya Juu and Fanya Chini terracing. Depending with amount of rain and farm specific needs the two terraces can be made level to store water or graded to slowly channel excess water out of farm in a safer and less erosive manner.

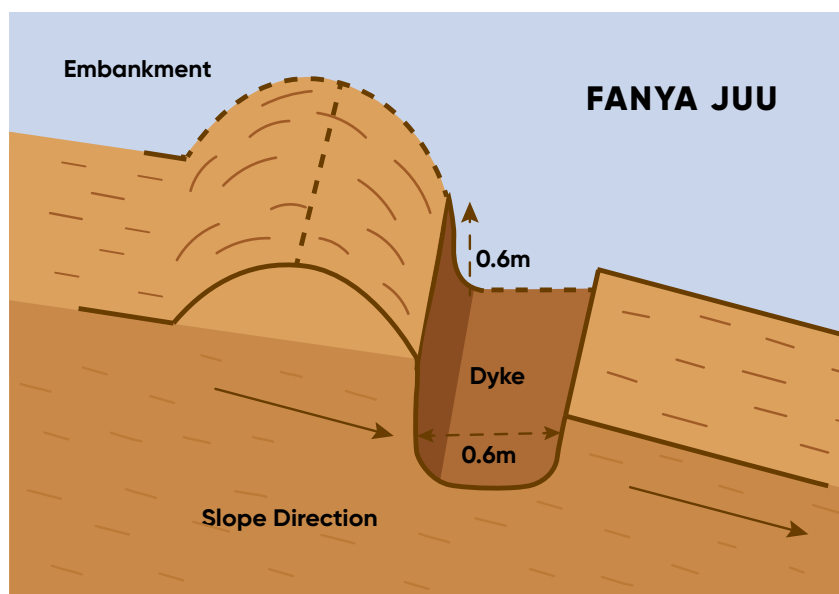


Why Terracing?

Terracing stands out as one of the most effective soil conservation methods, and research indicate that they can reduce surface runoff by 90% and soil loss by 80%. Particularly, on slightly to moderately sloped lands (5–25% slope). Terraces are versatile and can serve as primary conservation measures both in high and low rainfall areas, especially in landscapes with weak soils susceptible to erosion. Depending on soil hydro-conductivity, water held in a terrace ditch can be retained for significant periods, allowing the crops to have enough water supply

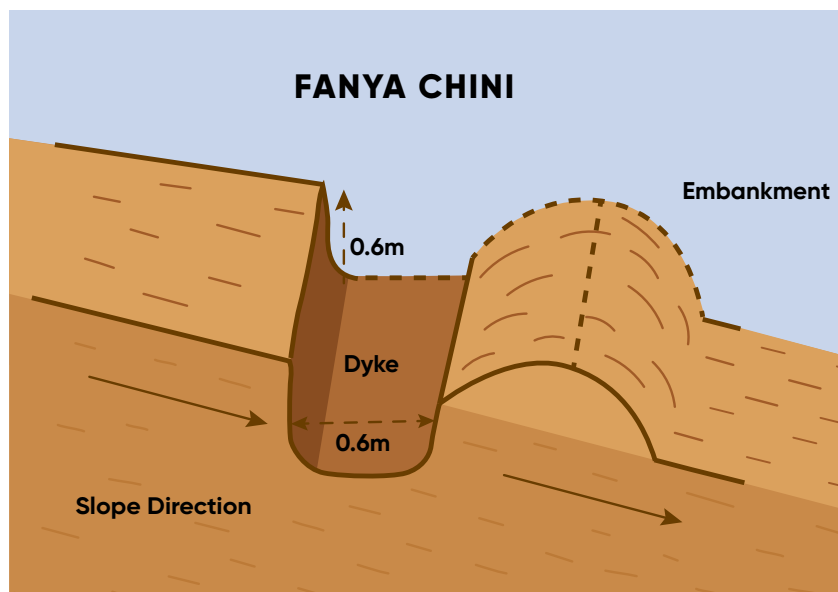
beyond the rain seasons. Among the many designs of terraces, Fanya Juu and Fanya Chini are the easy to construct and have less impact on the mechanical damages of the land. With time (depending on soil type and other erosion management practices on the farm, Fanya Juu terraces transform into bench terraces making the distance between them (Horizontal Interval) relatively flat and stable for farming. These characteristics make the two terraces suitable and preferred in smallholder farming systems.

90
 approx %
 of reduced
 surface
 runoff
 because of
 terracing



Fanya Juu terraces are constructed by excavating soil (forming a ditch) and mounting it uphill (Masereka, 1983; Mati, 2010).

Figure 1: Fanya Juu terrace - Excavated soil placed on the upper side of the dyke (ditch)



Fanya Chini terraces are constructed by excavating and mounting the soil on the lower hillside. These terraces mainly function as water-holding structures but dissipate surface runoff's erosive energy.

Figure 2: Fanya Chini terrace - Excavated soil is placed downside of the dyke (ditch)

The two designs can be used independently or together depending on the topography of the farm and soil hydrological characteristics

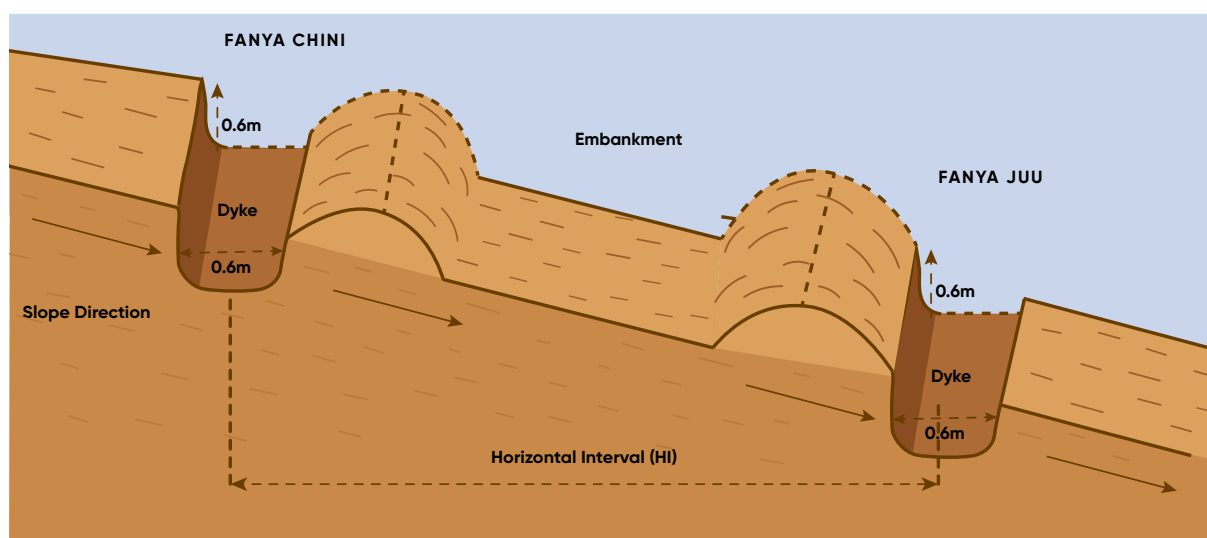


Figure 3: Combined Fanya Chini and Fanya Juu terraces

How to Construct Terraces



What are the tools required to construct either Fanya Juu or Fanya Chini terraces?

- i. Level line (Bunduki) – Marked sticks, string and spirit level
- ii. Tape measure
- iii. Sululu (Jembe made from car spring plates – removes big clods of soil that form a strong base for embankment, reducing the embankment damage)
- iv. Normal Jembe – for farms with easy to work soils
- v. Spade and Marking pegs

A. Measuring slope of the farm

Slope is an important factor that determines the speed of surface runoff on a land. **Remember:** Surface runoff contributes to soil erosion. The higher the slope the severe will soil erosion be if the land has no conservation measures and intensively plowed. As earlier mentioned, terraces works best on **5-25%** slopes, its also important in determining where to place terraces and calculating the inter-terrace distances.

Note: landscapes with concave curvatures should be assessed by an expert before terrace constructions



Procedure

Select two points along the area you plan to terrace.

- i. Place two marked sticks 20 m (Some sticks use 10m) apart along the slope; if using agricultural bunduki, you need two assistants to hold the sticks.
- ii. Tighten the string by pulling the sticks apart.
- iii. Attach a spirit level to the line and adjust until the spirit bubble levels. This is done by shifting the line up on the lower side stick or down on the upside stick.

Now, let us assume that after setting up the line and spirit level, you notice that one end of the line is higher than the other. Let us say it is 50cm meters higher. This means there is a 50cm (0.5-meter) rise in elevation over the distance between the two sticks. As shown in **Figure 4**.

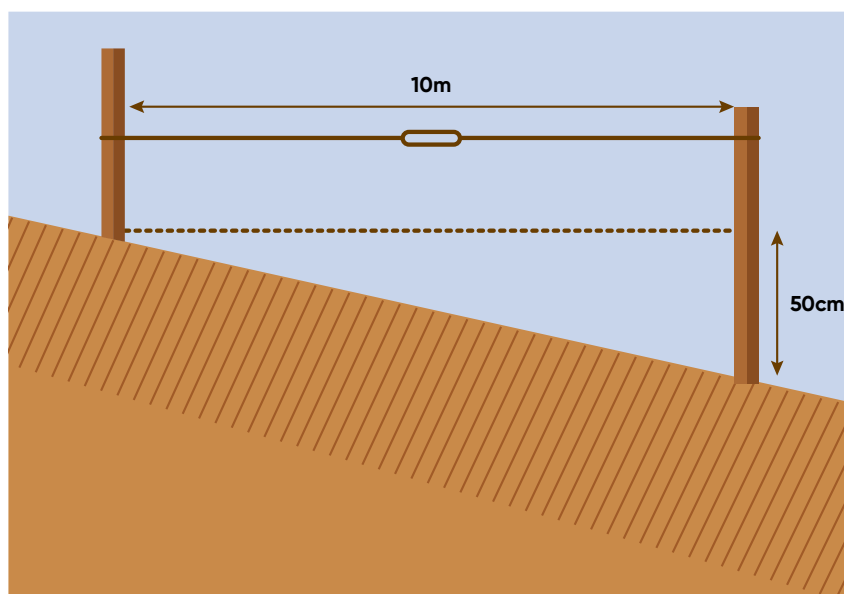


Figure 4: Example of line level use during slope measurement

B. Calculating the slope (%)

- i. Divide the rise (0.5 meters) by the horizontal distance (10 meters): $0.5/10$.
- ii. Multiply the result by 100 to express it as a percentage: $(0.5/10) * 100 = 5\%$.
- iii. Marked sticks eliminates these calculations by allowing farmers to read their farm slope directly on the scale

C. Determining Horizontal distance (Distance from one terrace to another)

Start by calculating Vertical Interval (VI) - refers to the height difference between two succeeding terraces and is calculated from %slope as shown

$$\text{Vertical Interval VI} = \left(\frac{\%slope}{4} + 2 \right) * 0.3$$

$$\text{Horizontal Interval (HI)} = \frac{VI * 100}{\%slope}$$

$$\text{Vertical Interval VI} = \left(\frac{5}{4} + 2 \right) * 0.3 = 0.975$$

$$\text{Horizontal Interval HI} = \frac{0.975 * 100}{5} = 19.5\text{m}, \approx 20\text{m}$$

Using our example, a farmer will construct a Fanya Chini at the uppermost part of the land to arrest the surface runoff coming from upslope and calculate the distance to where s/he will place Fanya Juu as follows

Note: The higher the slope, the shorter the HI; for instance, a slope of 25% will require a farmer to place terraces at a distance of 10m. See the table below for HI for different slopes [Economically and environmentally it's not feasible to construct terraces at slopes above 25%]

Table 1: Slope and equivalent horizontal interval for terrace placement and construction

Slope (%)	Vertical Interval (VI) (m)	Horizontal Interval (HI) (m)
5	0.975	20
6	1.05	18
7	1.125	16
8	1.2	15
9-10	1.28-1.35	14
11 – 12	1.43 – 1.5	13
13 – 15	1.58 – 1.73	12
16 – 20	1.8 – 2.1	11
21-25	2.18 – 2.48	10

Note: The HI is also affected by the soil texture and depth – in soils with high sand content or dispersible sub-layer clay, terraces should be constructed shallower than the recommended depth. In high rainfall areas, terraces should be graded at 3% to channel out excess water.

Terrace Construction

After determining the horizontal interval (HI), the farmer moves on to establish the contour of the line where the terrace will be built. The contour is a line that shows the path water takes across the slope, and it can be measured using a line and spirit level or a contour demarcating triangle.

The farmer should proceed to mark where terraces are supposed to be constructed using pegs. The pegs are hammered into the ground at intervals of six meters, with a 0.5-meter break following the contour line. The terrace dyke is then dug to a depth of 0.6 meters and a width of 0.6 meters. Soil is placed upslope for the “Fanya Juu” (uphill) and downslope for the “Fanya Chini” (downhill), as illustrated in the figures above.

Use a “sululu,” a jembe-like tool dig big clods of soil and places them strategically on either side of the dyke, depending on the terrace type. These clods are placed to form a strong base for the embankment. This ensures the terrace is stable to withstand surface run-off force.

Terrace Reinforcement

Terraces are premium conservation structures that when well maintained can transform sloped lands and prevent soil erosion. Good maintenance of the terrace involves desilting and reinforcement.

1. **Disilting** – With time soil from the farm and embankment get moved by water or animal (particularly goats) and deposited in the terrace dyke. This reduces the efficiency of the terraces and depending on the damage it could result into rill erosion that quickly transitions to gully erosion. To prevent this kind of damage, farmers should keep checking on their terraces and remove excess soil from the dyke. The removed soil should be placed on the embankment focusing on the damaged sections.
2. **Embankment reinforcement** – Terrace takes a significant part of land and it's only prudent to find a way to utilize it while also ensuring embankment strengthening. This is done by planting crops or grasses with good root structures that hold soil particles in place.



A farmer constructing a 'Fanya Chini' terrace

