16 • Subsurface Dams

Introduction

Subsurface dams built of soil across riverbeds have proved to be the most reliable and inexpensive water source in arid and semi-arid areas.
Subsurface dams prevent floodwater, which has filled the spaces between the sand particles in riverbeds, from being drained downstream thereby drying up the sand in riverbeds.
Subsurface dams let rainwater pass without reducing the flow to people living downstream. Subsurface dams do not require any maintenance. They cannot be eroded or clogged with mud or sand. Evaporation loss is almost non-existent since the water is stored in the sand.

Where can it be placed?

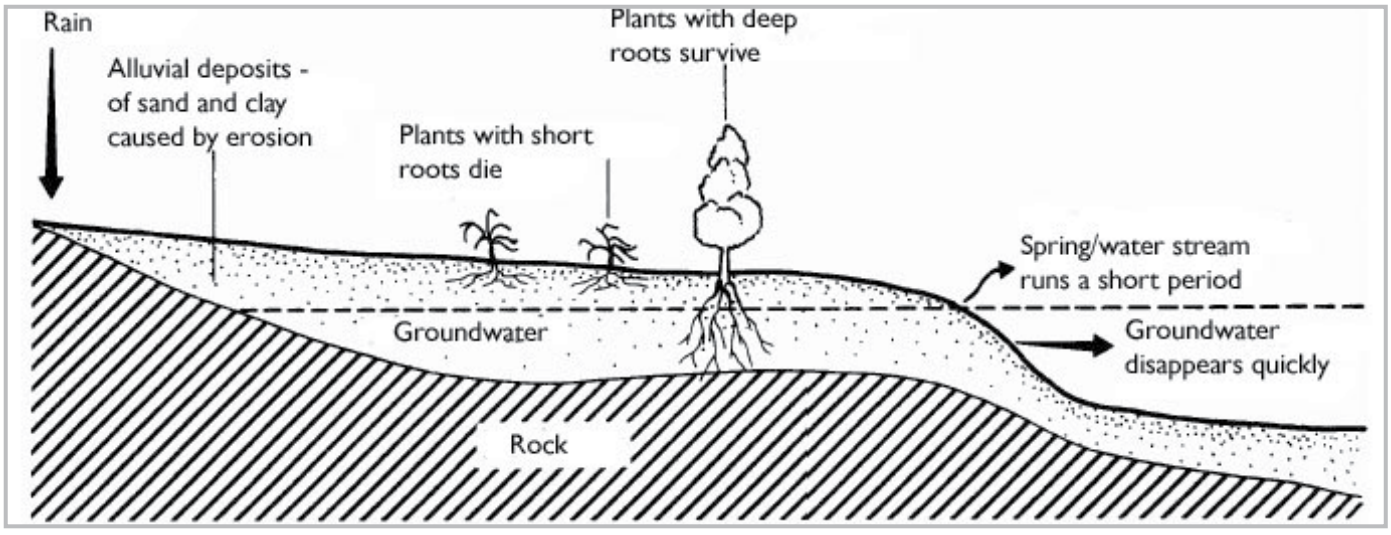
A subsurface dam should, preferably, be constructed on an underground dyke, because that provides a greater volume of water. A dyke is a hard layer under the sand, that already acts as a dam. Subsurface dams can be constructed in riverbeds with no dykes, but they might produce less water. It is also important to observe the following:

1) Coarse sand can store more water than fine-grained sand. Riverbeds containing coarse sand are therefore preferable.
2) Subsurface dams should not be located where waste from villages and other places can contaminate the water.
3) The area of the subsurface dam should not contain salty soil or salty rocks, because that will make the water salty.
4) The dam should not be built on boulders or fractured rocks, because they will cause leakage.

Identifying the presence of dykes

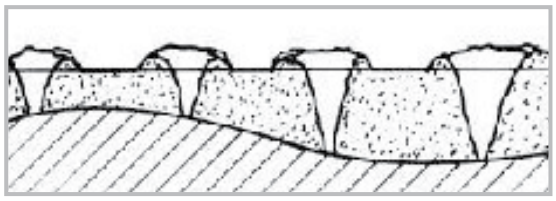
Underground dykes are easiest to locate a couple of months into the dry season by looking for the following:

a) Waterholes in an otherwise dry river -because there is always one or several dykes downstream of waterholes.
b) Dry stunted vegetation on riverbanks with taller evergreen trees just upstream. A dyke situated at the dry place



traps the water, which the green trees are using.

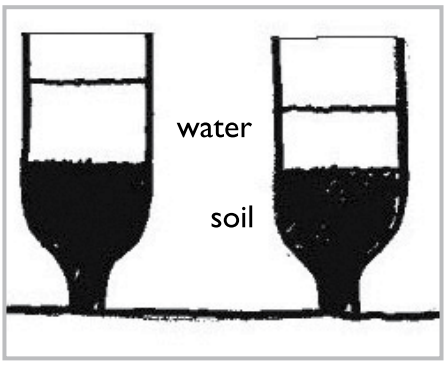
The dykes can also be located by digging trial pits and/or probing with an iron rod hammered into the sand and/or divining with brazing rods or sticks.



Design of the dam

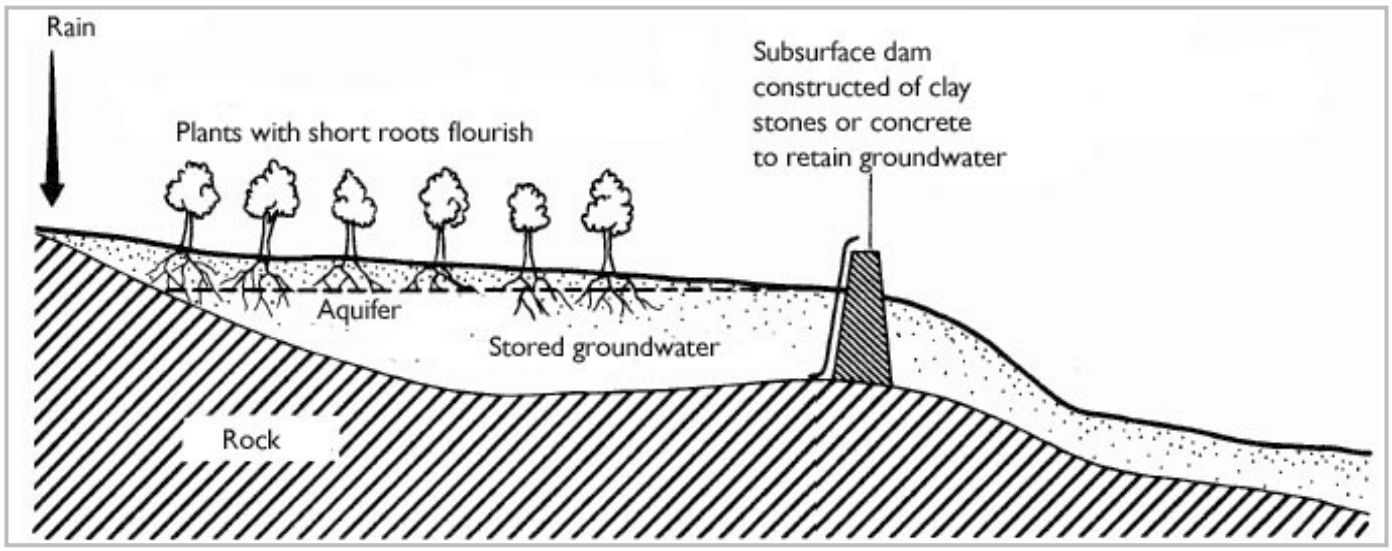
Dam wall

1. The dam wall must be well connected to firm soil at its complete length and at the two banks to prevent water from seeping through. This connecting area (key) should be at least 60 cm wide and 60 cm into the clay soil (the dyke). This key and the subsurface dam will be built with moist layers of the least porous soil that can be found in the area.
2. The porosity of soil can be found by observing the same amount of water seeping through samples of the various soil samples taken at a dam site. The soil samples are filled into transparent plastic bottles turned upside down with their caps and bottoms removed. The soil samples should measure 20 cm. They are saturated with water and 10 cm of water is added. The sample with the slowest infiltration rate is the most suitable soil for building a dam wall. This is the soil that will allow the least water to seep through (least porous).



The soil in the bottle at the left is best suited for dams since less water seeps through

3. The thickness of the dam is determined by the amount of time it takes 10 cm of water to seep through 20 cm of soil. If the infiltration time is 60 minutes, the minimum thickness (measured at the top) of the dam wall is 100 cm. If the water seeps through the soil faster, then the crest should be made 5 cm wider for every one minute it takes less than the 60 minutes. For example, if the infiltration time is 50 minutes, then the



thickness of the dam should be 150 cm, because 100 cm + (60 - 50) x 5 cm = 150 cm.4.

Construction

1. The sand overlaying an underground dyke is removed in a stretch that is 2 metres wider than the base of the dam wall.
2. The width of the base is excavated to a depth of 20 cm into the clay of the bottom of the riverbed.
3. A key at least 60 cm wide and 60 cm deep is excavated into the firm soil along the middle of the dam wall and reaching to the top of both ends of the dam wall in the two banks.
4. The key and dam wall are build of the least porous soil, which is moistened and compacted in layers of about 20 cm thickness until the top of the dam wall is reached.
5. The sides of the dam wall are cut so that they slope 45 degrees outward from the top and smoothened.
6. The upstream side of the dam wall is waterproofed by compacting a 5 cm layer of clay or cow-dung mixed with soil onto the dam wall.
7. Upon completion of the dam wall, sand is back-filled against both sides so that the top of the dam wall is equal with the level of sand in the riverbed.

Extraction of water

Water can be drawn from a subsurface dam through a well dug in the riverbed. It is also possible to connect a well dug in the riverbank to the dam reservoir with a tube, so that the water runs into the well. In this case the water must be treated before drinking.

Information and Illustrations by "Kenya Rain-water Association", Erik Nissen-Petersen, and the book by C. Burrow "Water Resources and Agricultural Development in the Tropics," 1987.