Short Notes, Reports and Announcements

Rainwater Harvesting for Agriculture in Semi-Arid Areas of Tanzania: Getting the Policies Right

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1. Introduction

There is a very strong overlap between semi-arid areas and poverty in Tanzania. Therefore, the war against poverty will be won or lost in the semi-arid areas. Due to over-dependence on agriculture, the efforts to eradicate poverty in Tanzania should focus on increasing substantially the productivity of three critical resources. These are labour, rainwater and land in that order of priority.

On the basis of variability of rainfall and the work by De Pauw (1984) and LRDC (1987) more than 50% of mainland Tanzania can be categorised as semi-arid. These areas receive less than 750 mm of rainfall in 9 out of 10 years and potential evapotranspiration exceeds rainfall during more than nine months of the year.

On the other hand the semi-arid areas are very important in Tanzania because:

- The high rainfalls occur in mountainous areas, where extensive mechanised agriculture is not possible
- Most of the livestock and wildlife in Tanzania graze in the semi-arid areas.
- Areas such as Tabora and Shinyanga regions are highly populated.
- As already mentioned, poverty, is rampant in semi-arid areas such as Lindi, Shinyanga and Dodoma regions.

Therefore, the low and variable rainfall should be managed in a way that will ensure adequate availability of soil-moisture and more effective use of rainfall by plants. This requires a consideration that rain is water and is a vital resource just like any other. In the past rain has not been treated as water let alone as a commodity. For this reason most of it is left to go to waste. Rainwater harvesting is aimed at managing rainwater from the moment it falls to ensure that most of it is used productively, if possible several times, before it is returned to the atmosphere by evaporation.

Evaporation returns a major part of the rainfall directly to the atmosphere from the soil before it is used for any purpose. From whatever point of view, this component of rainwater is wasted. However, the magnitude of this loss is not quickly realised by many people. This is because the loss of water through evaporation takes place in the form of water vapour. Water vapour is not visible, therefore huge volumes of water are lost unnoticed from the river systems, reservoirs and other water conveyance channels. The magnitude of this loss is illustrated in the example given in Box 1 and 2.

2. Rainwater Harvesting

The concept of 'Mashamba ya Mbugani' practised by many farmers in the semi-arid areas of Tanzania is a good starting point in conceptualising the meaning of rainwater harvesting. In this case, the farmers select to grow high-water demanding crops such as vegetables, rice and maize in the lower part of the landscape. What they are doing is to exploit the concentration of rainwater flowing into the valley bottoms from surrounding high grounds in the landscape. Therefore, from the crop production point of view, rainwater harvesting can be defined as the process of concentrating rainwater from a

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Box 1

Consider a reservoir with a surface area	=	$2km^2$
Evaporation in the viscinity of the reservoir	=	5 mm/day
The daily water loss	=	5 X 10-3 x 2 x 10^6m^2
	=	$10,000m^3$

This amount of water would supply an equivalent of 1000 mm of rain/irrigation to one-hectare farm. This means that water lost by evaporation from the surface of the small reservoir, in ONE DAY, is enough to supply irrigation water for one hectare for the whole year (!)

Box 2

Consider an area like Dodoma where the seasonal rainfall amount that can be exceeded 70% of the time is only 520 mm. Up to 300 mm can be lost through non - productive evaporation from the soil. Another 100mm can be lost through runoff. This leaves only 120 mm for plant transpiration. In other words under situations of poor rainwater management, 80% of the rainfall is not used for crop production

large land area into a small area so as to improve the soil-moisture status in the smaller area. This definition is however limited as it only deals with the spatial nature of the intervention. In practice this will not be adequate, as the rainfall is not evenly distributed in time.

To improve the problem of poor distribution in time, it is necessary to collect rainwater when it rains and store it for use to meet the water needs in the proceeding dry period. This view expands the meaning of rainwater harvesting. In the broadest sense, rainwater harvesting is defined as the process of concentrating, collecting and storing water for different uses at a latter time in the same area where the rain falls or in another area during the same or later time. The harvested rainwater can be used for many purposes.

The starting point of rainwater harvesting (RWH) is to capture rainwater where it falls for purpose of meeting the water needs of that area. This is normally called *in –situ* RWH. For this system to work it is necessary to prevent or reduce water losses from the root zone. This will be accompanied with cultural practices to ensure that crops make the most effective use of the scarce water.

The second step in RWH is called run-off farming, where the systems have two major components. These are Catchment Area (CA) which generates run-off, and Cultivated Basin (CB) where the run-off is concentrated, stored and productively used by plants. The parts are not so clearly distinct in the *in-situ* systems. Runoff farming is the major component of RWH for crop production designed specifically to overcome the problem of low amount and/or poor distribution of rainfall. The collection and concentration takes place during the rainfall event. Since the quantity of water on the target area will exceed the infiltration capacity, ridging, bunding (boarders and dikes) or excavations are applied to provide adequate surface storage to enhance infiltration. This system requires the cropped area to have a high soil -water storage capacity.

The third level of RWH is the flood diversion systems, normally with intermediate components such as means for collecting, transferring and storing the run-off. Due to the nature of rainfall in semi-arid areas, flash floods are common. Diversion of the floodwater into cultivated fields or storage facilities for later use is therefore an important component of rainwater harvesting. The diversion is achieved by raising the water level through temporary or semi-permanent weirs.

The three stages show that, rainwater harvesting for crop production is a continuum ranging from conventional soil and water conservation at one end and irrigation at the other end.

3. Majaluba System for Rice Production

It is estimated that more than 30% of rice production in Tanzania is from semi-arid areas (Kanyeka et al., 1994). This production is achieved by using rainwater harvesting. This is being

practiced by farmers in a number of regions, including Dodoma, Singida, Tabora, Shinyanga and Mwanza. In this system, farmers harvest runoff water from different sources and direct it into the bunded paddy fields called "majaruba".

The "jaluba" is a rectangular bunded and excavated basin. It is constructed by digging to a depth of about 0.2 m and the scooped soil is used to build a bund around the field perimeter to a height of about 0.3 m above the ground level. The bund height is raised over 2 – 3 seasons until it reaches a height of 0.7 m. Runoff is collected during the rainfall events and is directed in the "jaluba" where it is ponded to provide shallow flooding for paddy production. This way water is collected from large areas, say 10 ha and is concentrated in 1 ha where it is used productively. It is therefore possible to grow paddy rice in the generally semi-arid areas of Tanzania.

4. Policies and Strategies

A correct policy framework is necessary for dealing with the problems of the semi-arid areas. In the past, these problems were simplistically viewed as drought and erosion. Therefore, policies, strategies and programmes put a lot of emphasis on erosion control and led to strategies and programmes which focused more on the land rather than the people. These programmes were designed to stop soil erosion without due concern of the direct or opportunity benefits. The destocking which was implemented by HADO as a way of conserving the Kondoa Eroded Area (KEA), is a case in point (Mbegu and Mulenge 1983). The erosion control approaches of the past had focused more on the amount of soil lost rather than the effect of this loss on soil productivity (Stocking, 1988). This led to promotion of strategies such as cut-off drains which were mainly designed to dispose run-off even in semi-arid areas where plants suffer more from water deficit rather than nutrient shortage.

It has now been realised that shortage of soil-water for plants, is the major problem and that it can be mitigated by the other approaches than just drought-resistant varieties. The management and effective use of rainwater is the key to the solution. It is encouraging to note that farmers in many parts of the semi-arid areas are ahead of the policies and strategies. They have realized and have adopted different land uses in various units of the landscape to increase exploitation of the valley bottoms where rainwater and soil nutrients accumulate e.g. through "mashamba ya mbugani" approach which has led to significant increases in rice production in some semi-arid areas of the country. Correct policies and strategies to support such farmer efforts are needed.

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