Rainwater harvesting technologies for agricultural production: A case for Dodoma, Tanzania

by

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Abstract

Rainwater harvesting (RWH) is a method of inducing, collecting, storing and conserving local surface runoff for agricultural production. This paper presents a brief treatise, of rainwater harvesting, and its historical perspectives. The paper reviews major techniques of RWH for crop production being practised. These fall into three broad categories namely: In-situ, Internal (Micro) and External (Macro) catchment RWH. The paper finally gives specific examples of RWH techniques being practised in Dodoma Region and their extent of usage in the region. The paper concludes by looking at the past, current approaches and the role of RWH in Dodoma region and the appropriate techniques and their relative viability.

1. Introduction

1.1 The basis of water harvesting

Water is essential to all life – human, animal and vegetation. It is therefore important that adequate supplies of water be developed to sustain such life. Development of water supplies should, however, be undertaken in such a way as to preserve the hydrological balance and the biological functions of all ecosystems. This is crucial for marginal lands.

Consequently, the human endeavour in the development of water sources must be within the capacity of nature to replenish and to sustain. If this is not done, costly mistakes can occur with serious consequences. The application of innovative technologies and the improvement of indigenous ones should therefore include management of the water sources to ensure sustainability and to safeguard the sources against pollution.

As land pressure rises, more and more marginal areas in the world are being used for agriculture. Much of this land is located in the arid or semi-arid belts where rainfall is irregular and much of the precious water is soon lost as surface runoff. Recent droughts have highlighted the risks to human beings and livestock, which occur when rains falter or fail. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few. There is now increasing interest in the low cost alternative-generally referred to as 'water harvesting'.

1.2 Definition of rain water harvesting

Rainwater harvesting is defined as a method for inducing, collecting, storing and conserving local surface runoff for agriculture in arid and semi-arid regions (Boers and Ben-Asher, 1982).

Rainfall has four facets. Rainfall induces surface flow on the runoff area. At the lower end of the slope, runoff collects in the basin area, where a major portion infiltrates and is stored in the root zone. After infiltration has ceased, then follows the conservation of the stored soil water.

1.3 Historical perspectives

Various forms of rain water harvesting (RWH) have been used traditionally throughout the centuries. Some of the earliest agriculture, in the Middle East, was based on techniques such as diversion of "Wadi" flow (spate flow from normally dry water courses) onto agricultural fields. Other examples include the Negev desert (Evenari et al., 1971), the desert areas of Arizona and Northwest Mexico (Zaunderer and Hutchinson, 1988) and Southern Tunisia (Pacey and Cullis, 1986).

The importance of traditional, small scale systems of rainwater harvesting in sub-Sahara Africa has recently been recognised (Critchley and Reij, 1989). Simple stone lines are used,

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e.g. Burkina Faso and Mali; earth bunding systems in eastern Sudan, Kenya and the central rangelands of Somalia.

1.4 Recent developments

The potential of water harvesting for improved crop production received great attention in the 1970s and 1980s. This was due to the widespread droughts in Africa which left a trail of crop failures and a serious threat to human and livestock life. Consequently a number of water harvesting projects were set up in sub-Sahara Africa. The main objectives were to combat the effects of drought by improving plant production and in some areas rehabilitating abandoned and degraded land (Critchley and Reij, 1989). However, few of the projects have succeeded in combining technical efficiency with low cost and acceptability to the local farmers or agro-pastoralists. This was partly due to the lack of technical "know how" but also often due to the selection of an inappropriate approach with regard to the prevailing socio-economic conditions.

1.5 Major techniques of RWH for crop production

1.5.1 Site and technique selection

Setting priorities; the people's choice:

Before selecting a specific technique, due consideration must be given to the social and cultural aspects prevailing in the area of concern as they are paramount and will affect the success or failure of the technique implemented. This is particularly important in the arid and semi-arid regions of Africa and may help to explain the failure of so many projects that did not take into account the people's priorities. In arid and semi-arid Africa, most of the population has experienced basic subsistence regimes which resulted over the centuries in setting priorities for survival. Until all higher priorities have been satisfied, no lower priority activities can be effectively undertaken.

Technical know-how and criteria:

In addition to the socio-economic considerations, a water harvesting scheme will be sustainable if it also fulfils a number of basic technical criteria AS SHOWN IN Figure 1. The chart shows the basic technical selection criteria for the different water harvesting techniques.

1.6 Major categories of RWH

In crop production systems, RWH is composed of a runoff producing area normally called the catchment area (CA) and a runoff utilisation area normally called cropped basin (CB) Therefore RWH systems for crop production are divided into different categories basically determined by the distance between CA and CB as follows:

1.6.1 In-situ rain water harvesting

The first step in any RWH system involves methods to increase the amount of water stored in the soil profile by trapping or holding the rain where it falls. This may involve small movements of rainwater as surface runoff in order to concentrate the water where it is wanted most. In-situ RWH is sometimes called water conservation and is basically a prevention of net runoff from a given cropped area by holding rain water and prolonging the time for infiltration. This system works better where the soil water holding capacity is large enough and the rainfall is equal or more than the crop water requirement, but moisture amount in the soil is restricted by the amount of infiltration and or deep percolation. The in-situ RWH is achieved mainly by the following means:

Deep tillage: Tillage normally assists in increasing the soil moisture holding capacity through increased porosity, increasing the infiltration rates and reducing the surface runoff by providing surface micro-relief or roughness which helps in temporary storage of rain water, thus providing more time for infiltration.

Previous research results have shown that the depth of tillage is the most important factor controlling or affecting soil moisture characteristics. Deep tillage helps to increase porosity, reduce surface sealing of the soil and permits roots proliferation to exploit soil water and nutrients at deep horizons (Hudson, 1987).

Significant reduction of surface runoff and increase in crop yields have been shown to occur with increased depth of tillage in Hombolo, Central Dodoma.

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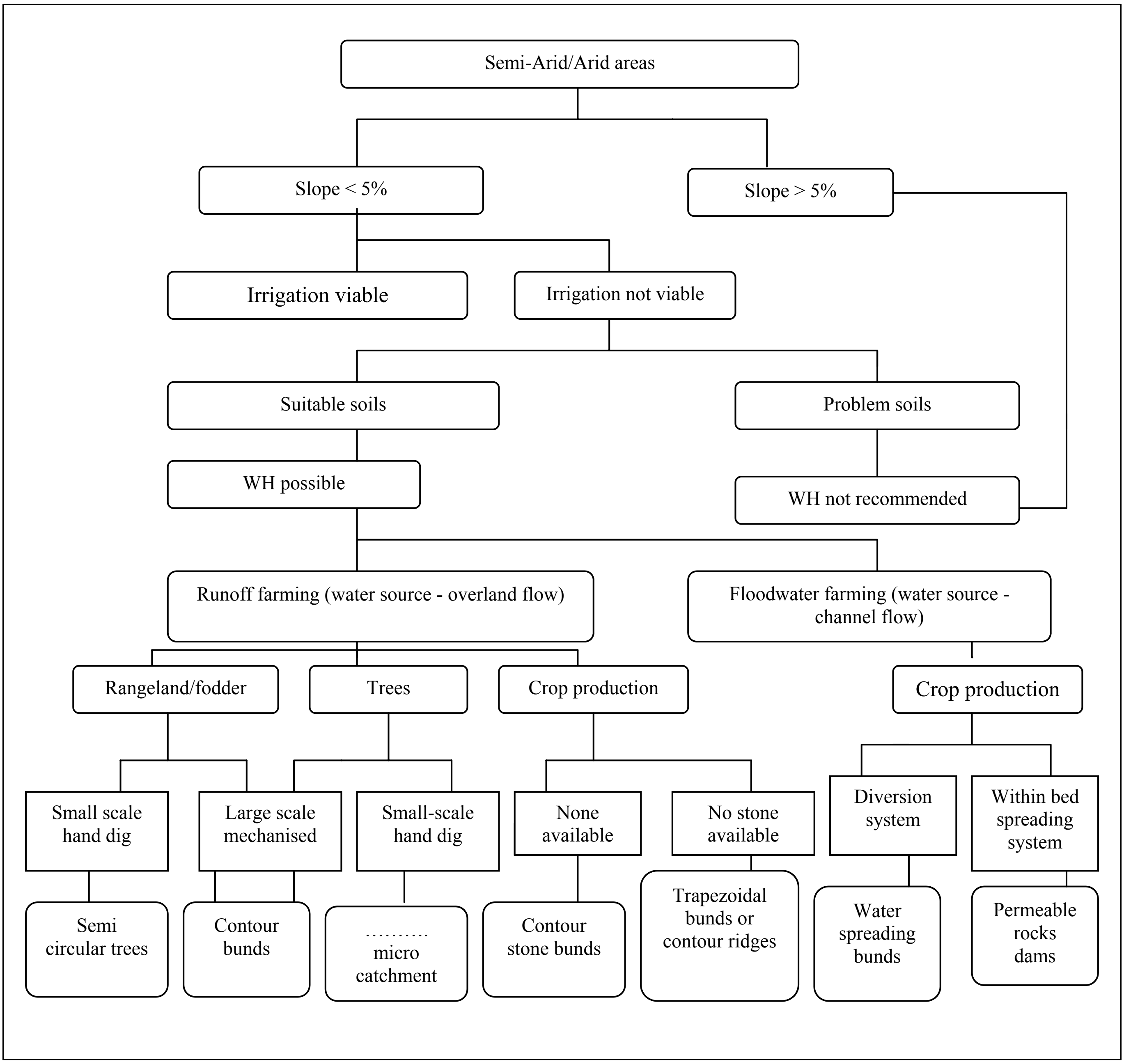

Figure 1: System selection

Contour farming and ridging: This is important where cultivation is done on slopes ranging from 3% and above. All farm husbandry practices such as tilling and weeding are done along the contours so as to form cross-slope barrier to the flow of water. Where this is not enough, it is complemented with ridges which are sometimes tied to create a high degree of surface roughness to enhance the infiltration of water into the soil.

Agronomic practices: Practices such as use of FYM, timely weeding and mulching are used to enhance water availability in the soil by improving the water holding capacity and reducing soil water evaporation.

1.6.2 Internal (Micro) catchment RWH

This is a system where there is a distinct division of CA and CB but the areas are adjacent to each other.

This system is mainly used for growing medium water demanding crops such as maize, sorghum, groundnuts and millet. The major characteristics of the system include:

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Pitting: These are small semi-circular pits dug to break the crusted soil surface (Figure 2). In West Africa where they are called 'Zay', the pits are about 30 cm in diameter and 20 cm deep. FYM is added in the pits thus permitting the concentration of water and nutrients. Seeds are planted in the middle of the pits. The same system is called Katumani pitting in Kenya. They are used in areas with rainfall of between 350-600 mm.

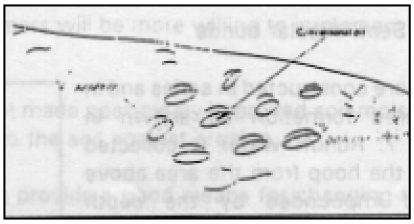

Figure 2: *Layout of pitting RWH*

Strip catchment tillage: This involves tilling strips of land along crop rows and leaving appropriate sections of the inter-row space uncultivated so as to release runoff. It is normally used where the slopes are gentle and the runoff from the uncultivated parts add water to the cropped strips (Figure 3).

The Catchment: Basin Area Ratios (CBAR) used are normally less than or equal to 2:1. The system can be used for nearly all types of crops and is easy to mechanize.

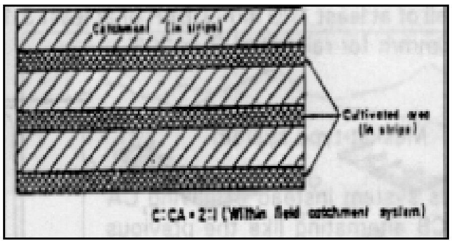

Figure 3: *RWH with strip catchment tillage*

Contour bunds: This system consists of small trash, earth or stone embankments, constructed along the contour lines. The embankments trap the water flow behind the bunds allowing deeper infiltration into the soil (Figure 4). The height of the bund determines the net storage of the structure.

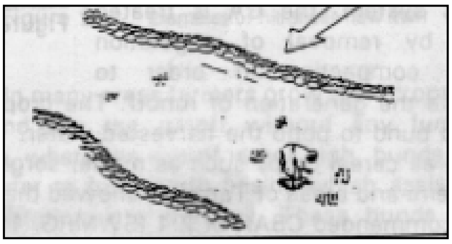

Figure 4: *RWH with Contour bunding*

The water is stored in the soil profile and above ground to the elevation of the bund or overflow structure. This is a versatile system for crop production in a variety of situations. They can be easily constructed but they are limited to availability of power (for earth moving), stones and trash. They are useful where ground slope is not more than 5%, soil depth is at least 1 m and rainfall intensity is less than 20 mm/h for 1-hour duration storms with P = 20%. They are designed with CBAR of less than 3:1.

Semi-circular bunds: These are constructed in series in staggered formation as shown in Figure 5. Runoff water is collected within the hoop from the area above it and impounded by the depth decided by the height of the bund and the position of the tips. Excess water is discharged around the tips and is intercepted by the second row and so on. Normally the semi-circles are of 4-12 m radius with height of 30 cm, base width of 80 cm, side slopes 1:1.5 and crest width of 20 cm. The percentage of enclosed area which is cultivated depends on the rainfall regime of the area. Basic requirements of the semi-circular bunds are:

- ground slope must be less than 3%,
- soil depth, at least 1 m,
- average annual rainfall of at least 100 mm,
- CBAR of at least 3:1 and
- rainfall intensities of I60 equal to 50 mm/h for rainfall of P = 20%.

Meskat-type system: In this system instead of having CA and CB alternating like the previous methods, here the field is divided into two distinct parts, the CA and CB, whereby the CB is immediately below the CA. (Figure 6).

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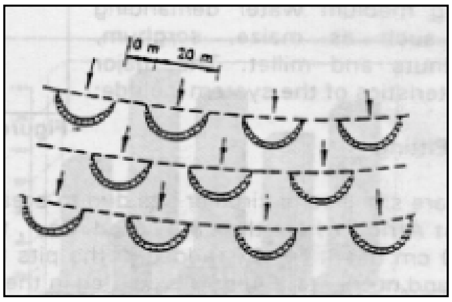

Figure 5: *RWH with semi-circular bunding*

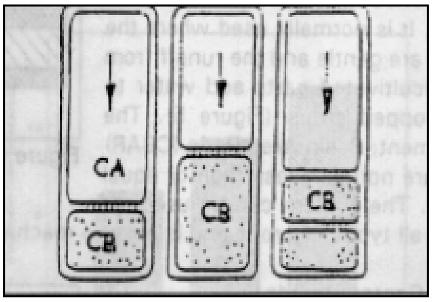

Figure 6: *RWH with Meskat-type bunding*

In this system, the CA is treated either by removal of vegetation and compaction in order to increase the generation of runoff. The cropped basin (CB) is enclosed by a U-shaped bund to pond the harvested water. The CBAR is 2:1. It can be used for almost all cereal crops such as maize, sorghum and millet. Experimental results from semi-arid areas of Tanzania showed that optimum yields were obtained with the recommended CBAR of 2:1 (SWMRG, 1995b).

Land conservation aspects: Micro-catchment approaches have a high potential for combining water harvesting with soil conservation. The main problem is that, in most projects there has been a bias towards promoting conservation rather than soil and water conservation with production. Conservation of both moisture and soil has two major advantages:

- Due to increased crop yields, farmers will be more willing to implement and maintain the system;
- The rapid vegetation development made possible by improved soil-moisture status, provides early protection to the soil against erosion.

Micro-catchment rain-water harvesting, provides a good means for changing from soil conservation based on just runoff control to a focus on land husbandry integrating conservation and production.

1.6.3 External (Macro) catchment RWH

This is a system that involves the collection of runoff from large areas which are at an appreciable distance from where it is being used. This is sometimes used with intermediate storage of water outside the CB for later use as supplementary irrigation.
It is difficult to differentiate this system from conventional irrigation systems but in this paper the system is called RWH as long as the water for harvesting is not available beyond the rainy season.

This system involves harvesting of water from catchments of areas ranging from 0.1 ha to thousands of hectares either located near the cropped basin or long distances away. The catchment areas usually have slopes ranging from 5-50%, while the harvested water is used on cropped areas which are either terraced or on flat lands.

When the catchment is large and located at a significant distance from the cropped area the runoff water is conveyed through structures of diversion and distribution networks. The most important systems include the following:

Hillside sheet/rill runoff utilisation: In this system, runoff which occurs on hill-tops (with stone outcrops), sloping grounds, grazing lands or other compacted areas flow and naturally collect on low lying flat areas. In many areas farmers grow their crops on the wetted part of the landscape and use the runoff without any further manipulation or management.

However, where the runoff is not high, bunds are constructed on the cropped area in order to form earth basins which assist in holding the water and increasing infiltration into the soil. These bunds are important when the cropped area is not at the bottom of the landscape. However earth basins are used to facilitate the distribution of the water even if the cultivated area is on flat land. Several designs of these earth basins are used and sometimes are mentioned as types of RWH systems by themselves. These include, for example trapezoidal basins bunded on three sides, rectangular basins bunded on three sides e.g. Teras (Figure 7), and cultivated basins bunded

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on all the four sides with only small inlets and overflow spillway, e.g. ‘majaruba’.

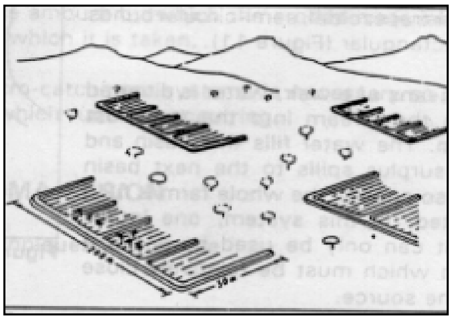

Figure 7: *Examples of hill sheet flow RWH*

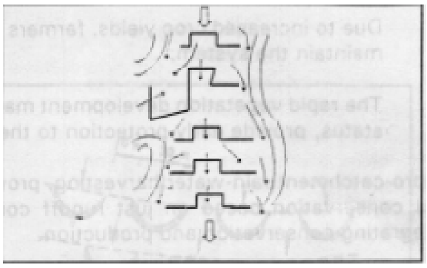

Figure 8: Flood water harvesting with the stream bed

Floodwater harvesting within the stream bed: This is a system that uses barriers such as permeable stone dams to block the water flow and spread it on the adjacent plain and enhance infiltration. The wetted area is then used for crop production (Figure 8).

Ephemeral Stream Diversion: This system involves means for diverting water from its natural ephemeral stream and conveying it to arable cropping areas. There are two main methods of diverting and distributing the water.

In the first system, the cultivated field close to the ephemeral stream is first divided into open basins using either trapezoidal, semi-circular bunds or rectangular (Figure 9).

By means of a weir, water is diverted from the stream into the top most basin. The water fills the basin and the surplus spills to the next basin and so on until the whole farm is fully wetted.

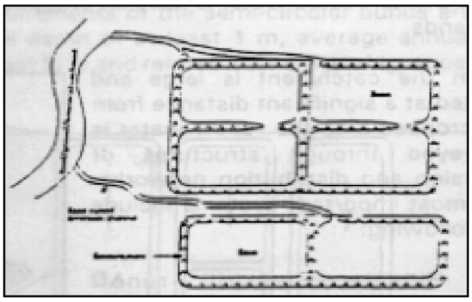

Figure 9: Ephemeral stream diversion

In this system, one intake point can only be used by a single farm which must be relatively close to the source.

In the second system, the field is divided into a closed rectangular basin such as “majaruba” and the water is diverted using a weir and a series of channels to deliver the water to the basins (Figure 10). The system works using the same principles of surface flood irrigation and it can therefore serve several farms which may be located far away from the intake.

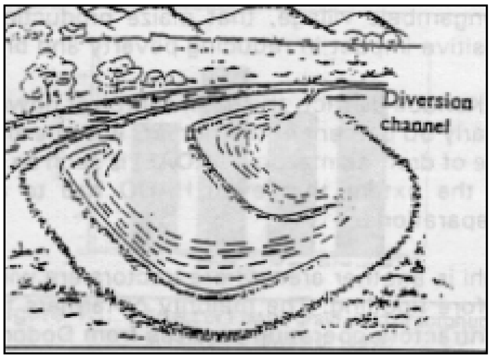

Figure 10: *Ephemeral stream diversion with distribution canals*

RWH with storage: Sometimes macro-catchment RWH, produces high volumes of runoff that can not be stored in the soil profile. In such circumstances, the harvested water is stored in dams or water holes. Small dams are normally constructed in rolling topography where creeks can be found and the dams are constructed across them.

Water holes are storage ponds dug in a flat terrain and they are normally referred to in their Spanish name “Charco dams”. In India they are called ‘tanks’. They are normally used to store runoff generated from hillside catchments with sheet or rill flow. The system requires methods for controlling siltation

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especially if the area is prone to soil erosion, evaporation, and seepage losses especially if the subsoil is sandy.

Land conservation aspects: Land conservation role of macro-catchment RWH is much difficult to visualise. In reality macro-catchment RWH system condemn one part of the land (the catchment) for the benefit of another (the cropped basin). This is occurring naturally on the catena, where fine particles, nutrients and organic matter are disproportionately lost in the eroded fraction from catchment areas. This is referred to as the “enrichment factor”, and is the amount by which the eroded material is richer in nutrients than is the soil from which it is taken.

For this reason careful planning of macro-catchment systems is necessary so as to avoid the degradation of land from which runoff is occurring.

2. Experiences from Dodoma region

2.1 Extent of use of in-situ RWH techniques in Dodoma

2.1.1 Deep tillage

Deep tillage requires high draft power which is normally in short supply in many parts of Dodoma region. There are three main areas where deep tillage is practised extensively. These are: parts of Kongwa District, Kondoa District and the Bahi rice growing area.

In Zoisa division of Kongwa district, tractors are the main source of power and there are farmers who farm and cultivate more than 50 ha of land. This has led to the area becoming a leading producer of maize with substantial marketed surplus. During the visit by the study team, there was clear evidence, for example in Songambele village, that maize production through improved tillage has had a positive impact in reducing poverty and bringing sustainable development.

In Kondoa district, the main source of power is draft animals which are used by nearly 90% of the farmers in some areas to achieve deep primary tillage. The use of draft animal power (DAP) is such an important aspect of the farming system to the extent that even HADO had to allow oxen into the KEA during land preparations.

Bahi is another area where tractors are widely used to cultivate the paddy basins before flooding. The majority of farmers till their fields using tractors hired from contractors operating services from Dodoma town.

In the remaining parts of the region, with the exception of small pockets e.g. Berege village in Mpwapwa, deep tillage is rarely achieved since the hand hoe is the main method of cultivation. In many areas, farmers do not implement primary tillage before the planting of sorghum and millet.

Despite the large herd of cattle in Dodoma, DAP is not widely used because of the following reasons:

- Traditional cattle owners are reluctant to use their animals for work,
- Only ploughs are available,
- Animals are poorly fed during the dry season prior to the main work period, and
- Lack of knowledge in using other animals such as donkeys.

2.1.2 Contour farming and ridging

Contour farming or ridging is not widely practised in the region. However, some ridging is used for crops such as groundnuts and sweet potatoes in some parts of the region. Some of the reasons advanced by the farmers for not using ridging include:

Lack of power and equipment to till and ridge the land, and poor implementation of ridging which leads to low crop population density. This was raised by farmers in Mpwapwa district especially in relation to groundnuts production.

2.1.3 Agronomic practices

Weed control is one of the most widely used methods of conserving soil moisture. This is sometimes done twice or thrice in order to reduce water loss through evapotranspiration. Research carried out in the region has shown significant increase in crop yields when FYM is used.

The potential for farm yard manure (FYM) is not fully exploited. Villagers keep large number of livestock in kraals where enough easily accessible manure accumulates.

Observations during the study revealed that the use of FYM is restricted to the fields near the

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homesteads and no farmer takes manure to the distant fields. Most soils in Dodoma would respond to use of FYM since they have a low organic matter content due to sparse vegetation cover and high temperatures that cause fast microbial activities.

In recent years, bylaws on the use of FYM have been instituted in certain parts of the region such as Mpwapwa district. Specifically, the by-laws require kraals not to be left to fill with manure, thus encouraging the availability of the manure for use on cropped fields even by those farmers who not own cattle (Box 1).

> Box 1 Commercial transportation of manure
>
> During the visit to Vlkonje village, the team met two entrepreneurs who have invested in ox-cart and were being paid by rich cattle owners to remove FYM from the Kraals as required by the by law. They were also being paid by farmers with no livestock, to transport the manure to their fields. They were being paid TShs. 600/= by the Kraal owner and another TShs. 600/= by the farm owner.

2.2 Extent of use of internal (micro) catchment RWH in Dodoma

2.2.1 Pitting

There is no use of systematically designed pits in the region. However, in the traditional system of sowing, large pits are made which collect runoff during the early growing stages of the crop. They thus act as RWH pits.

2.2.2 Strip catchment tillage

No evidence of the use of this system was found during the study in the region.

2.2.3 Semi-circular bunds

No evidence of the use of this system was found in the region during the study period.

2.2.4 Meskat-type System

There is no use of systematically designed Meskat system in the region. However, due to microtopography water may be redistributed within the field from elevated portions into low lying ones and therefore increasing soil moisture availability to plants in these areas, which sometimes may also be of high fertility. This is evidenced even in rangelands whereby high elevation areas remain dry for a long period after the beginning of the rain season while low lying areas become covered with green vegetation soon after the beginning of the rainy season.

Similarly due to high moisture content, low lying areas remain green for a longer period after the rainy season has ended.

2.2.5 Contour bunds

These are used in many parts by few farmers due to the fact that it is the means of soil and water conservation system being extended by extension offices. In HADO areas of intervention, for example, HADO's main strategy for promoting soil and water conservation has been the construction of earth bunds along the contours as a runoff control measure within the cropped areas. This was started in 1984, and 10 years later a total of 775 km of contour bunds had been constructed.

The major failures of both the District extension services and HADO project, is that there was very little technology transfer to the farmers. Therefore, technical staff are still laying the contours and there is no spontaneous adoption of the techniques by the farmers.

2.3 Extent of use of external (macro) catchment RWH in Dodoma

2.3.1 Hillside sheet and runoff utilisation

This system is the most widely used. It eploits the valley bottoms and plains where the runoff collects, by growing high water demanding crops. Farms in these areas are called "Mashamba ya Mbugani" and are common in many parts of the region. These are mainly used to grow maize. Flooded valley bottoms are used for sugar cane and vegetable production. This method of exploiting naturally generated runoff is widely used in the drier areas of central and southern Dodoma. The majority of the farmers have at least one "Shamba la Mbugani" which indicates that most of the maize is produced by this method of water supply.

These areas are also attractive to many farmers due to their high fertility levels which is a result of fertility enrichment from the up-slope areas where nutrients are transported and deposited in these plains during seasonal

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flooding. One of the most important characteristics of this system is the lack of flood control measures. Thus this system does not use large investment of labour to manage the water. If anything is done at all, it is to leave the catchment area uncultivated in order to generate more runoff. However, few farmers collect the runoff and lead it into bunded fields or majaruba for growing paddy rice.

In some villages there is high demand of the low lying areas which receive runoff to an extent that there is land marketing and renting of these valuable pieces of land.

2.3.2 Floodwater harvesting within the stream bed

This system is not being used at all in Dodoma region although the potential exists.

2.3.3 Ephemeral stream diversion

The most commonly used stream diversion system is the one with closed bunded basins (majaruba), elaborate diversion and conveyance channels. This is the system supporting the rapid expansion of paddy production in the western part of Dodoma region using ephemeral streams (Box 2).

Box 2: Project assistance to RWH for rice production

- The Bahi paddy rice production RWH project comprises of two main components. The first component of the project was initially started with a pilot project of 20 ha in 1982 under funding from FAO/USAID. It has been expanded by farmers on their own and now covers an area of about 550 ha. The second component is a 150 ha area which was funded by IFAD in 1990. These two components are adjacent to one another and the beneficiaries are the villagers at Bahi although some non-residents from as far as Dar es Salaam, have farms in the village.
- IFAD is assisting to develop similar projects.
- In Bahi village, there is evidence that the majority of the farmers are quite well off and to some extent have escaped poverty. The Bahi scheme clearly indicates the role that RWH can play in poverty reduction. The main problem with this system is the initial capital investment because diversion of flood water from the river requires structures such as weirs and distribution canals to divert the water into the fields. Apart from the initial costs, flood diversion schemes are also faced with problems such as damage to the diversion works during flash floods, siltation of weirs and canals resulting from deposition of sediment carried with flood water and problems of control and distribution of the flood water.

2.3.4 RWH with storage

This is also a widely used system is Dodoma especially in Dodoma district. In the 1950's many earth dams were constructed for livestock and domestic water supply. Some of them are substantially large such as the Hombolo dam across the Kinyasungwe river. The waters of this dam are currently being used for full scale irrigation of maize and vegetables. In other parts of the region, dug out ponds collect water and villagers exploit this for domestic, livestock and vegetable production. These are mainly found along roads where contractors dig out soil materials for road construction. Due to the apparent widening use of ponds, during the UNDP pilot project (URT/94/001) it was felt necessary to undertake a fresh assessment of construction and utilisation of such ponds. This activity was subcontracted to the SWMRG and was implemented at Hombolo. The main findings are summarised in Box 3.

Box 3: Main findings from Pilot CRAS at Hombolo

The pilot experiment took place in a year of serious dry spells and no grains were harvested from plots without stored water for supplementary irrigation. At the same time in those plots where some supplementary irrigation was provided yields of about 1..5 t/ha were realised. Economic analysis showed that paddy production using RWH with storage reservoir will break even at about 1 t/ha and make much more money at 2.2 t/ha. This indicates that RWH with reservoir storage for supplementary irrigation would be good for the production of rice.

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The major problem facing storage schemes has been the lack of maintenance. Most of them are silted up and their cost of rehabilitation is prohibiting. Silting is caused by poor utilisation of catchment areas and lack of protection of the reservoirs. Further to these, livestock walks directly, into the reservoir to drink, which increases the damage to the reservoir by puddling.

The villagers have been using water collected in natural depressions or man-made reservoirs but have shown very little interest in adopting the technology. This observation is made from the fact that although the benefits of the technology have been very well demonstrated in Dodoma, very few individuals or villages has adopted the construction of their own reservoirs. Where one has been built, people just use the water until it dries without considering the possibility of increasing water availability by constructing more reservoirs or expanding existing ones.

3. Observations and conclusions

3.1 Current, past approaches and the role of RWH

The following observations and conclusions are based on studies carried out by the authors in the semi-arid areas of Tanzania, particularly Dodoma. Other areas include Kilimanjaro, Shinyanga and Mwanza regions.

- Majority of farmers in Dodoma were found to know the importance of water conservation and harvesting and they have been practising it in different ways at different scales.
- There is already an informal land use plan along the catena, existing in many villages, for exploiting runoff. In this plan, low water requiring crops (e.g. millet) are grown on elevated ground and high water demanding crops (e.g. maize) are grown at the bottom of the landscape where runoff collects.
- It was found that there is a significant use of water conservation and harvesting for crop production by farmers in Dodoma region.
- Where water harvesting has been adopted for crop production, there is a clear evidence of increased farmers' income and poverty reduction.
- However, the water harvesting systems preferred and practised by the farmers have not received enough technical support mainly because they operate outside formal projects.
- This may be due to lack of regional policy and strategy geared towards the development of different rain water harvesting systems for crop production.
- There is a need to formulate a coherent policy or strategy towards strengthening extension and technical support of rain water harvesting for crop production.

3.2 Appropriate techniques and their relative viability

- Individually based water conservation/harvesting systems to a large extent have been more successful than collective based systems. Communally owned systems such as rain water harvesting and storage reservoirs were found to suffer from lack of protection, care and maintenance.
- Water harvesting initiatives and interventions need projects aimed at improving existing individual farmer practices on water harvesting in Dodoma and beyond.
- Potential for increasing cash income is a big factor affecting the adoption of rain water harvesting in Dodoma. It was noted for example that where it has been adopted, RWH is used for the production of maize, paddy rice and vegetables – crops that can be sold for cash.
- Promotion of water harvesting should be done in conjunction with crops, which can be sold for cash. In some places this can be achieved by improving marketing channels for existing crops.
- From the socio-economic stand point the potential is high because where clear benefits have been demonstrated, farmers have been ready to undertake, at their own initiative, huge capital investment in rain water harvesting. Examples include purchasing tractors to attain deep tillage and construction of bunds for paddy rice production.

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- Micro-catchment approach to RWH has a high potential for improving land conservation. Macro-catchment may, to some extent, increase the risk of erosion on the area used for yielding runoff.

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