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Water Conservation, Harvesting and Management (WCHM) - Kenyan Experience

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ABSTRACT

Water management for agricultural production is becoming increasingly important in Kenya. Despite the emphasis on soil conservation in the 1970s and 1980s, on structural soil and water conservation (SWC) measures, to convey and discharge runoff from agricultural land, no consideration was made on the needs of the Arid and Semi arid lands (ASAL).

This paper is an outline of water conservation, harvesting and management (WCHM) activities in Kenya. Further, there is a documentary evidence on two video sets; one entitled "The sun will still rise" a twenty two minutes documentary on awareness creation and promotion of WCHM, and another one entitled "Runoff a foe or a friend" a twenty seven minutes documentary on WCHM, with emphasis on training and outlining technology development and dissemination.

It can be said that, in Kenya the land users or farmers are way ahead of agricultural extension, in efforts to harness and utilize runoff water for crop production as the farmers are innovators in their own rights. In this regard emphasis is being put on training technicians on improvement of what the land users are doing, and development of para-professionals within the land users or farmers. To ensure sustainable and increased agricultural production for improved livelihoods of the land users.

INTRODUCTION

Water management in Soil and Water Conservation Programs are gaining recognition in the World. In Kenya, up to 1980s the emphasis was on soil erosion control, by use of structural measures to convey and discharge runoff from agricultural land. However, Soil and Water Conservation (SWC) is now being recognized as a land husbandry practice, for management of soil and water resources, in order to sustain agricultural production and improve the living condition of land users.

The arid and semi-arid lands (ASAL) constitute about 80 percent of the total Kenyan land area, which supports about 50 percent of the livestock population and about 35 percent of the human population. The land users in these areas are generally poor, and on account of food shortages there is a dependency on food handouts for survival.

This paper tries to outline the WCHM activities in Kenya. However, there is a documentary evidence on two video sets; one entitled "*The sun will still rise*" a twenty two minutes documentary on awareness creation and promotion of WCHM, and another one entitled "*Runoff a foe or a friend*" a twenty seven minutes documentary on WCHM, with emphasis on training and outlining technology development and dissemination.

Further, the paper gives a clear description of WCHM for crop production purposes and tree/ fodder establishment, and the role of micro/macro-catchments. In-addition a description of water harvesting for domestic/livestock purposes is given including surface/subsurface runoff water harvesting. And also an indication of efforts in rangeland rehabilitation/development and in research/extension linkages.

In Soil and Water Management activities, the terms water conservation (WC), water harvesting (WH) and water management (WM) are very close in meaning and quite often used interchangeably. Within the National Soil and Water Conservation Program (NSWCP) in the Soil and Water Conservation Branch (SWCB) in the Ministry of Agriculture in Kenya, the three terms are explained as follows (SWCB 1997b):-

*Water conservation (WC)***:** This is prevention of surface flow of excess rain, by prolonging the time for infiltration. Thereby increasing the amount of water to be stored in the soil profile. The most common practices for WC include level bench terraces, and cultural measures as tillage techniques and soil fertility improvement practices.

*Water harvesting (WH)***:** Is the collection and concentration of run off for productive purposes. Run off is properly utilized for production of crops, trees, fodder and pasture establishment. It also provides water for domestic and livestock use. This term is more commonly used, and is often used instead of water conservation or water management.

Water Management (WM): Is a broad term that encompasses the regulation, control, use, conservation and harvesting of water in agriculture. It may also refer to efficient or economical management of available water in agriculture and use of surface and subsurface water resources in agricultural production.

In conclusion, it can be said that training in WCHM has been extended to most of the technicians at managerial level, but little at operational level (Fig. 1). Therefore, there is need to intensify training for the frontline extension workers. However, it is noted that, the land users or farmers are innovators in their own right and thus they are way ahead of extension workers. In this regard WCHM is considered as a panacea to alleviating the Kenyan ASAL problems in agricultural production.

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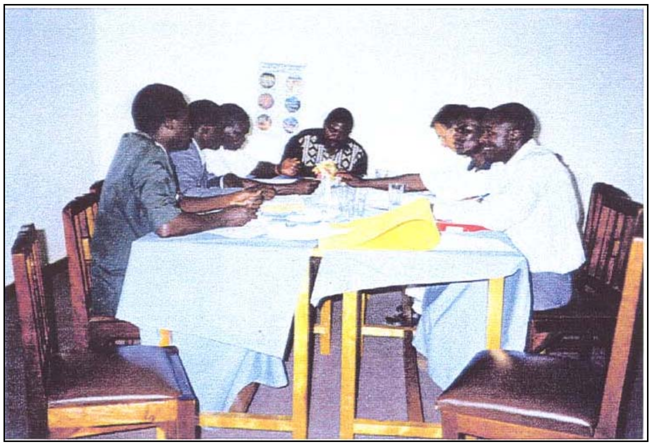

Figure 1: WCHM training – group work in class.

Figure 2: Water harvesting for fruit tree establishment, on V-shaped bunds (negarims) – Mwingi District.

Figure 3: Water harvesting from road into retention ditches for banana / fruit trees establishment and food crops production - Mwingi District.

Water conservation, harvesting and management for crop production

There is no single method that is solely used for crop production, as there is a great variation in land use, farming systems, socio-economics, soils and rainfall, and the fact that in ASAL the rainfall amount, distribution, and duration is highly variable and the main limiting factor.

Water Conservation techniques for crop production include: Conservation bench terraces, fallow systems, tied ridges, conservation tillage, contour furrows, mulching, rotation and mixed cropping. In WC the objective is to conserve and increase the soil moisture, by ensuring that runoff is minimized and all rainwater infiltrates into the soil.

In crop production water harvesting is very important and is categorized into micro/macro -catchments systems. In micro-catchment system, runoff water is harvested from short slope catchments (within field catchments) or in-situ. This system includes techniques such as negarims (v-shaped bunds) (Fig. 2), contour bunds, and contour ridges. Another important aspect is use of *fanya juu* terrace for water harvesting. Conventional *fanya juu* terrace channel is 0.6m deep by 0.6m wide, and farmers in Machakos and Kitui have modified the dimensions and enlarged the *fanya juu* terrace channel up to 1.5m deep and 1m wide. Thus the *fanya juu* terrace ridge traps the water and the channel acts as a retention ditch, for impounding runoff water from roads or homestead compounds (Mutunga et al., 1998).

The other aspect of WH is macro-catchment systems that are characterized by long slope (SWCB, 1997a) and external catchment systems or techniques with large catchments, even with collecting arms to supply water to cultivated areas. That is why the system is normally referred to as external water harvesting. In this system, catchment has to be established based on the crop water requirement, area to cultivated area ratio is a very important aspect and the design rainfall, runoff coefficient and collection efficiency factor. Some common techniques under macro-catchment systems include:- semi-circular bunds, trapezoidal bunds, road runoff harvesting into basins and into retention ditches (Fig. 3). However, it is noted that micro-catchment systems have high collection efficiency than macro-catchment systems, as water is deeply ponded, more evenly spread, and evaporation losses are low (SWCB, 1997a).

Floodwater farming and water spreading is another form of WH for crop production. This involves diversion of ephemeral river into adjacent flat land, or interception of floodwater in valleys into basins for crop production. In both systems the crops benefit from fertile deposits transported by runoff water.

On WCHM for crop production, through field reports and observations (Mutunga et al., 1998), it can be said that quite a number of land users/farmers, particularly in Ukambani Districts (Machakos, Makueni, Mwingi and Kitui) are way ahead of agricultural extension and can be taken as innovators in technology development. In this regard promotion of farmer innovations, with improved research and extension linkages can lead to technology breakthrough in WH for crop production in Arid and Semi-Arid lands (ASAL). That is bound to lead to sustainable systems for improved food self-sufficiency/reliance, and improved livelihoods of land users.

Through research it has been established that on station WCHM for crop production leads to increased yields (Itabari 1999). However, dissemination of such findings to land users or farmers is poor. This can be attributed to research that was donor driven, ignored land users participation, did not recognize traditional techniques (knowledge) and the fact that on station research conditions do not reflect actual situation at farm level. This situation is now changing and participatory technology development is picking up, with promotion of farmer innovations.

To enhance adoption of WCHM, agricultural extension and research have developed linkages in Soil and Water Management, where the researchers and extensionists work together, in identification of problem areas for research, and meet periodically to discuss developments in their respective areas. This can be referred to as part of participatory technology development, since the land users are also involved at catchment level in planning and trials of the various technologies.

Water harvesting for range development

It is noted that about 50 percent of the livestock population in Kenya is in ASAL, and that most of the ASAL is range land, defined as land not under crops but is used for grazing. It could be stony, with shallow infertile soils, and in low rainfall areas. Most grazing lands are community owned, and efforts to control grazing in these areas or rehabilitation of the land are curtailed. Thus mismanagement through overstocking and overgrazing combined with frequent droughts in ASAL leads to poor grass cover, accelerated erosion, and consequently serious fodder shortage.

Increasing the water supply through WCHM on grazing land can lead to increased forage that can lead to reduced grazing area per stock and improved livestock survival. It is also noted that de-stocking, rotational grazing, closing the grazing area, and reseeding have been found effective in increasing forage.

Pitting is one technique that has been used to rehabilitate grossly degraded, eroded, and rangeland that is unproductive due to overgrazing. This involves construction of a series of small pits of varying width and length, categorized as conventional pitting, Kitui pitting, or Katumani pitting (Mutunga, 1998). Conventional pits are normally 2.5–3 m long, 0.75 m deep and wide and spaced at 0.9–1.2 m and overlapping each other along the contours. Kitui pits are semi-circular, with a surface area of 5 – 12m^2, with a 15 – 30cm high bank and a whole 50cm deep at the center. While Katumani pits have a surface area of 1.5–3.0 m^2. Overall the pits collect runoff water and allow it to infiltrate, trees can be planted on the trench embankment, followed by closing the area to allow grass to regenerate.

Water harvesting for domestic and livestock purposes

Included under this category is not only systems as defined in WH, but also efforts/systems to manage, utilize or tap surface or subsurface ground water resources for livestock production, and for domestic purposes. Some WH techniques that are common with land users include:- water holes/pans, rock catchments – mainly found in Kitui (see figure 4), road/compound runoff into underground (sub-surface) tanks – mainly in Kitui, Machakos and Laikipia, and roof catchments –found in most parts of the country including high rainfall areas (Figure 5). On the other hand efforts in utilization of sub-surface water resources are

Figure 4: Rock water harvesting for domestic and livestock purpose - Kitui District.

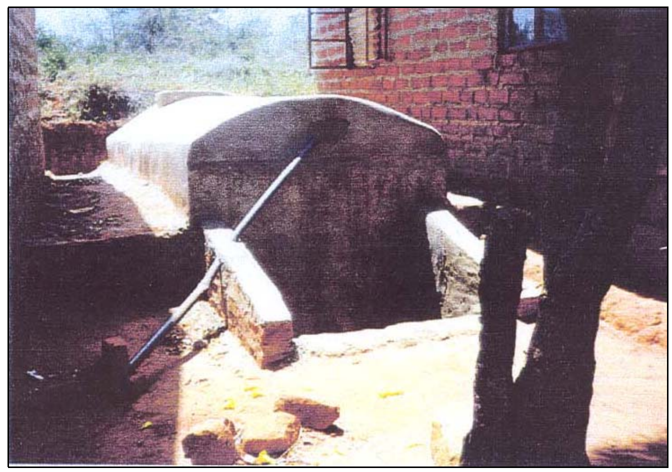

Figure 5: Roof water harvesting into sausage tank - Machakos District.

reflected in development of shallow wells – common in Marsabit, Kitui, Kwale, Kilifi, Nyanza, and Eastern Province. Spring protection/development – common in Machakos, Mbeere, Meru Districts and Kisii. Sub-surface (sand) dams (see figure 6) are also considered under this category.

Water holes/pans is a common name for small earth dams in Kenya that have storage capacities not exceeding 20,000m^3, with a shallow depth not exceeding 5m and shape varying from rectangular, square or round and common side slopes of 1:2.5 to 1:3 (Mwarasomba and Mutunga, 1995). They are excavated on natural ground level, on locations that they can collect runoff water and are quite common in Narok, Kajiado, Ukambani, and in North Eastern Province. In Kenya sub-surface dams are also referred to as sand dams and the two terms are used interchangeably. However, a subsurface dam is an earth clay wall constructed across a sand riverbed that impounds sand upstream and consequently becomes submerged in the sand. While a sand dam is a subsurface vertical barrier, constructed of masonry or concrete across a seasonal riverbed with foundation at the bedrock, to intercept water flow and impound sand upstream for water storage. The dam wall is raised by stages each season until it reaches the required height. The sand dams are common in Ukambani Districts, Tharaka, and Mbeere Districts (SWCB, 1997a).

In WH for domestic/livestock purposes, it is important to involve the land users or farmers right from project identification, planning, and implementation, to ensure a strong feeling of ownership and guaranteed operation and maintenance for sustainability. Further, of great importance is to recognize and utilize wherever possible and appropriate, the traditional knowledge, expertise and management practices of the land users. This is done through the participatory methodologies, of the catchment approach strategy. In the catchment approach, a catchment is taken as a focal area of concentration of resources and efforts in a given period of time, and not necessarily a hydrological catchment. The objective of the catchment approach is to systematically and effectively, conserve one focal area at a time (SWCB, 1997a). Through development of catchment action plan (CAP) for community services and individual land management plans (LMP) for individual farmers or land users in a catchment. Overall soil and water conservation activities are taken as part of a whole farm approach, with the aim of improving the living conditions of land users, through improved livestock production and provision of safe water for domestic purposes, using simple techniques.

A major challenge in water harvesting for domestic and livestock use is the need for proper operation and maintenance, as most of the structures are community owned, with donor input in the implementation stage. Thus, where the local land users are not fully involved from the start, operation, and maintenance is a big problem. Even where the land users are involved, there is a tendency for ownership feeling to decrease with time, resulting in poor operation and maintenance. However, in the catchment approach strategy, an important aspect is formation of a catchment committee (CC) through an election. The catchment committee is responsible for ensuring future operation and maintenance of community structures and also

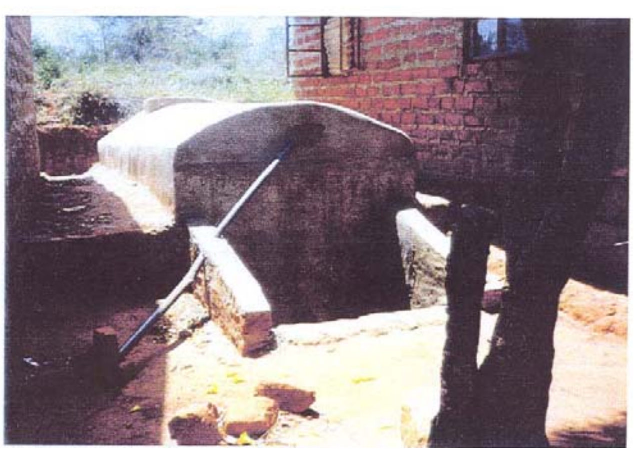

Figure 6: WCHM training - participants visit to a sand dam and have discussions with land users.

for implementation of all LMP at individual farm level. Further, the catchment committee ensures the by laws are followed and levy penalties and consumer charges where needed.

It is noted that, the most successful WH for domestic and livestock purposes, is that undertaken by individual land users or farmers. The operation and maintenance is guaranteed, with a strong feeling of ownership, as a result of individual capital investment that is demand driven. However, community water harvesting for domestic and livestock purposes is inevitable, for structures as water pans, rock catchments, sub-surface (sand) dams, and spring protection and development. Thus to improve operation and maintenance of such structures, education and training of technicians and land users has to be intensified (Figure 6).

CONCLUSION

Intensification of education and training in WCHM for land users and technicians, including development and production of information materials is of vital importance. As there is a wealth of experience and knowledge in place. That can be used with a view of making land users or farmers para-professionals, to supplement the efforts of agricultural extension. Further, through promotion of land users or farmer innovations, and farmer-to-farmer extension system, that is sustainable to ensure increased agricultural production in ASAL.

There is great potential for increased agricultural production in ASAL. If the efforts of the land users or farmers in managing the available runoff water, is accorded full support in the national policy framework and infrastructure as roads and markets are improved.

It is noted that in semi-humid areas, WCHM is picking up on crop production, as the land users are trying to be food self sufficient/reliant and sell the surplus to generate cash for family requirements as clothing and school fees for the children. On the other hand, in semi-arid areas the land users are balancing on WCHM for crop production, domestic and livestock purposes. As this is a transition zone for crop production and livestock. However, in arid areas the land users concentrate on livestock, as they are pastoralists, and thus WCHM is basically for livestock and domestic purposes.

Problems limiting implementation of WCHM in Kenya

At land user or farmer level, it is noted that a dependency syndrome has developed over time in ASAL and incentives as food for work, construction materials, and tools are always expected. Thus with no formal fund/credit facility for WCHM, individual or community interests are curtailed, due to high level of poverty in ASAL. And with virtually no information or data available for rigorous cost benefit analysis, to enable the would-be financiers have confidence in funding or give credit, WCHM implementation is threatened.

At institutional level, agricultural extension officers lack confidence in WCHM, despite intensified training undertaken in the last five years. Thus extension officers need time to develop practical skills from knowledge gained through training. Further, the National Soil and Water Conservation Program (NSWCP), funded by Swedish International Development Cooperation Agency (SIDA) for the last 26 years, came to an end in June 2000, creating a vacuum in WCHM specific activities in ASAL.

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