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Knowledge and Practices for Rainwater Harvesting Technologies in Semi Arid Region of Mbeere North Sub County, Kenya

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Abstract:

Technology refers to the application of scientific knowledge for practical purposes and it is closely related to development throughout the world, in informal organisations, factories, and farming system. Adoption of technological production can assist a resource-poor country to overcome its natural handicaps and conversely a county which relies on its rich diversity of natural resources may stagnate and fall victim to the perils of underdevelopment. In Kenya, there is poor accessibility of viable safe drinking and nearly 70% of the people reside in rural areas whereby the main sources of livelihood are dependent on rainwater.

This study examined knowledge and practices for adoption and utilisation of rainwater harvesting technologies in semi-arid region of Mbeere North sub-county, Kenya. More specifically the study examined sources of knowledge for rainwater harvesting technologies, factors that enable households adopt rainwater harvesting technologies, benefits of utilisation of rainwater harvesting technologies among households and the challenges faced by households in adopting rainwater harvesting technologies.

The study found out that rainwater harvesting is essential for households both in rural and urban areas of Kenya and its largely practiced. The key factors influencing adoption and utilization of rainwater harvesting technologies include, the available knowledge about rain water harvesting RWH and some of the benefits that are as the result of adoption; water harvested is used for irrigation, for livestock, cooking, drinking, washing and too sold to non-harvesters or those that harvest less. Availability of capital and labor too contribute to the adoption of water harvesting technologies for farm and for domestic use.

The study recommends the following; education and training of farmers on modern technologies of rainwater harvesting, emphasizes on community mobilization and sensitization about rainwater harvesting technologies, stresses on the need for more contact with agricultural extensions at the village level and to recommend that value chain analysis of crop production be undertaken.

Keywords: *Adoption, rain water harvesting, utilization, sources of knowledge Technology*

1. Introduction

Kenya is deprived of access to viable safe drinking and water for sanitation. Target 10 of the MDGs intended to lessen by half the fraction of the people globally by 2015 that did not have access to safe water and would also focus on Kenya where almost 70% of its people reside in rural areas whereby farmers depend on rain for plants growth and keeping of livestock as the main sources of livelihood. Additionally, the World Bank (2010) reported that the population was increasing at a rate of 2.6 %/year. Kenyans highly depend on seasonal rainfall. In his report, Malesu et al. (2007) anticipates temperature increase and rainfall decline in semi-arid areas by 2030 due to climate change. Water scarcity in Kenya is perilous to its social-economic development hence makes the realisation of Vision 2030 and the international development agenda in the SDGs is doubtful. The water problem is strengthened by the change of climate and rising water demand because of the growth of the population and urbanisation.

Kenya chapter of the Billion Dollar Alliance for Rainwater Harvesting initiative was launched in 2017 by the Kenyan government and its partners from the development and business community. It was continent-wide and was designed to scale up farm pond technology for agribusiness and livelihood resilience for dryland farming systems. The aim of the alliance was to build one million farm ponds in Kenya to intensify water storage in the farms. The ponds are to be constructed at the rate of 100,000 ponds every year for ten years.

Medina (2016) defined water harvesting as the process in which the rain that falls on a site is captured, diverted and stored for use either on the same location or on a different one for use. Rainwater is collected and stored for use at home, for small scale productive activities and watering of the garden (Mwenga-Kahinda, et al., 2007). Rainwater

harvesting for farm use can highly increase its productivity, boost food security and reduce poverty. It is applied to lessen time-based water supply problems and add-on conventional water supply systems (Mwenga-Kahinda, et al., 2007). In the semi-arid rural areas of the Middle Eastern region of Kenya, the practice of water harvesting has not been exploited in totality. Therefore, water harvesting techniques can be useful devices for enhancing the ability or resilience of households to mitigate the problems faced by rural farmers.

In the semi-arid area of Embu County, water is a constraining factor that limits productivity for both crop production and livestock productivity. The county semi-arid has only 5% area under irrigation and there is much potential to increased irrigation through water harvesting and storage in ponds and pans. Up to 80% of the population is food secure and 20% of the population face perennial food shortages and insecurity due to low productivity (GoK, 2013). The hot and dry semi-arid regions of Mbeere North and South mainly experience acute food insecurity. The areas receive low and unreliable rainfall (GOK, 2013).

There is substantial knowledge of rainwater harvesting in Kenya. Mbogo (2014) analysed the types of technologies for rainwater harvesting practiced in Mbeere Sub-county of Embu County. Among the key findings were that the type of household dwelling influenced the respondents to embrace rainwater harvesting technology. The study did not delve into how the harvested water is utilised. Given the issue of climate change and insufficient rainfall, water scarcity has become endemic thereby undermining farm productivity. In a water-deficit region of Mbeere it was found prudent to probe how the rainwater harvested is utilized and the effect it has on household resilience and quality of life. Therefore, this study explored key factors influencing the adoption and utilisation of rainwater harvesting technologies for domestic and agricultural production among households in Evurore ward, Mbeere North Sub- County.

2. Data Collection

The study used a descriptive survey design for data collection. It was used because it helps to describe the state of affairs as it exists at present (Baxter, Hastings, Law, & Glass, 2008). The design investigated the causal factors of household adoption and the use of rainwater harvesting technologies in Evurore ward, Mbeere North Sub-County. This design was important because it enabled me to gather evidence related to the problem of the study to determine the status of the phenomenon under investigation by applying personal contact and interviews. The design enabled the researcher accommodate a large sample size which is a prerequisite in the generalization of results. The unit of analysis was the factors that influence household adoption and the utilisation of rainwater harvesting technologies in Evurore Ward, Mbeere North Sub- County. The units of observation in this study were the male and female household heads and or active participants in water harvesting from the two locations; Muringari and Kiang'ombe of the study area together with the key informants and the focus group discussants. In the study, the study population was defined as all individuals in the two locations that make up Evurore Ward who are in engaged in water harvesting and making use of it. The study targeted the male and female household heads and or active participants in the farm system. The study sample size was 114 (n) which represented 15% of 760 (N) farmers from the list obtained from the Ward Agricultural officer. According to Mugenda and Mugenda (1999) for descriptive studies, 10% to 20% of the target population is adequate for a sample. I selected two locations: Kiang'ombe and Muringari which are in the lower drier zone of Evurore Ward and practice water harvesting. I obtained the list of the households practising water harvesting techniques from the Ward Agricultural Officer. The list had 760 (N) farmers. In order to select the sample, an interval of six was determined using the formulae below;

Interval (I) = N/n where;

N is total population and n is the sample size.

Interval = $\frac{760 \text{ total population}}{114 \text{ sample sizes}} = 6$

114 sample sizes

Thereafter systematic sampling was used to select farmers who were interviewed at household level. This study employed both qualitative and quantitative methods of data collection. The methods of data collection were triangulated to ensure the validity of the data collected and the analysis. Primary data was gotten through face-to-face interview. This aided to explain or clarify questions to the respondents. Six Key informants who were extension officers working in Evurore ward, Mbeere north sub-county were purposefully sampled. They comprised of field officers who work closely with the farmers. In this study, household interviews were conducted using a structured questionnaire to establish the farmers' opinion on adoption and utilisation of rainwater harvesting.

In this study focus group discussion was done with four different groups of farmers, two in each location. Two for youth farmers 18-35 (one for male youth and one for female youth). The other two were for adult women and men farmers. The researcher used only four groups for FGDs to optimise on the available time. The groups were homogenous to allow free expression hence more focused results. The researcher facilitated the discussion as her two undergraduate assistants helped in taking of the notes. The use of two assistants was to ensure no information is lost. After the FGD the notes of the two assistants were compared and one set of notes compiled for each FGD. The participants in each FGD were 10 and each FGD lasted a maximum of one hour.

Secondary sources of data such as journals, newspaper, review books, research reports, scientific magazines, websites, and other documentations were used. This enhanced the field report.

The researcher used Key Interview Guide that had discussion topics. The questionnaire had quantitative questions. In several sections, the questionnaire focused on different issues that address the research objectives. It was administered face to face.

3. Site Description

Mbeere North Sub-County of Embu County is found in the South eastern slopes of Mt.Kenya. It is found between latitude 0.9672 S and 0.47330 S, and between longitude 37.47680 E and 37.91238 E. It covers an area of 744.80 sq.km and has population of 89035. On the other hand, Evurore ward covers an area of 409.9 sq. km with a population of about 45,582 (KNBS, 2009). Mbeere people live on the lower side of Embu which receives relatively low rainfall. They grow cash crops like Cotton, and food crops such as maize, beans, cowpeas, pigeon peas, and green grams. Temperatures range from 20°C to 30°C. The coldest month is July with an average monthly temperature of 15°C and the warmest month is September with an average monthly temperature raising to 27.10°C. The area experiences two different rain seasons with a bi-modal rainfall pattern. One season is between March and June when the long rains are experienced and the other one is between October and December when the short rains are experienced (County Integrated Development Plan, 2017).

4. Presentation of Findings

4.1. Sources of Knowledge for Water Harvesting

The study objective was to find out sources of knowledge for water harvesting technologies. The study found out that 45 (39.5%) of respondents obtained information about rainwater harvesting technologies for domestic use from public health officers, from agricultural extension officers 22 (19.3%), from seminar attended 22 (19.3%) and from their neighbor 22 (19.3%). Only 3 (2.7%) obtained information from a local hardware technician. Information obtained from qualitative sources confirmed that knowledge for rainwater harvesting technologies was obtained from several sources in the sub-county. A key informant, an agricultural officer attribute:

"In this area, farmers obtained knowledge on water harvesting techniques from seminars organized by NGOs and the Ministry of Agriculture, from their neighbours, chiefs baraza and agricultural shows."

Prackash (2011) notes that rainwater harvesting training offers instructions on the concept and technology of rainwater harvesting for domestic use. The trainings entail water optimization, common rainwater harvesting systems, selection of appropriate rainwater harvesting technology, storing methods and contaminants in rainwater harvesting system.

Source of Information	No.	Percent (%)
Agricultural extension officer	22	19.3
Neighbour	22	19.3
Hardware	3	2.7
Public health officer	45	39.4
Seminar	22	19.3
Grand Total	114	100

Table 1: Source of Knowledge for Rainwater Harvesting for Domestic Use

4.2. Sources of Information for Water Harvesting for Farm Use

The sources of information for water harvesting for farm use were: Agricultural extension officer (56) 49.1%, a seminar attended (14) 12.2%, and chief's Barraza (14) 12.3%. Other sources of information included: public health officer (7) 6.1%, those who read about it were (11) 9.6% while those who heard from a neighbour were (11) 9.6%. Only 0.8% received information from the local hardware. Key informant reports show that some farmers learned about rainwater from study tours where they visit other places. This agrees with Star (2018) that reported that a number of Members of parliament from Murang'a had visited Kenyatta village in Yatta constituency to learn about water pans.

Black *et al*, (2012) found attending training, conferences, workshops, seminars, field trips and exposure visits as a way of capacity building of the target recipients whereby the local people are enlightened on how to make use of the water bodies without contaminating them. Also, Mwariri (2003) in a study on the diffusion of small-scale rainwater harvesting technologies in the arid and semi-arid areas of Nakuru reveals that though some farmers did not visit farmers' training, they observed and copied what their neighbors did.

In addition, the average number of water technologies installed on farms was 2 with the maximum number of technologies installed being 5.

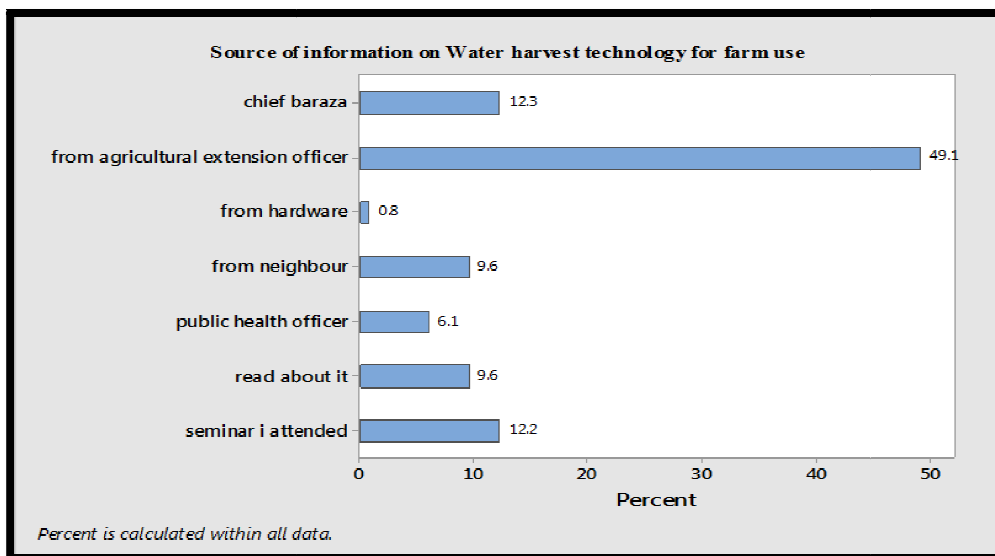


Figure 1: Sources of Information for Water Harvesting for Farm Use
N=114

4.3. Source of Labour for Installing Farm Technologies

The findings of the study show that Source of labour installation of water harvesting technologies in the farm included: paid labour 53 (46.5%), followed by 34 (29.8%) who erected and maintained the technology by themselves, and Household-joint labourer 27 (23.7%). Murgor (2013) notes some limitations in adopting modern technologies and inputs. These include; Very high cost of hired labour, high transportation cost for agricultural products, high cost of construction materials and lack of credit access or shortage of capital.

	No.	Percent (%)
Household-Joint Labour	27	23.7
Paid labourer	53	46.5
Self	34	29.8
Grand Total	114	100

Table 2: Sources of Labour for Installation of Water Harvesting Technologies

4.4. Advantages of the Farm Technologies Used for Water Harvesting

The most mentioned advantage of the chosen water harvesting technologies in the farm was the fact that they were easy to maintain (63) 55.3%, followed by technology affordability (30) 26.3% and less labour to install and maintain (21) 18.4%. Qualitative information showed that rainwater harvesting technologies in the farms help prevent much runoff hence controlled soil erosion and besides boosts the soil moisture that even when the rain is scarce the crops are not very much affected by the scorching heat. One female adult farmer noted as follows: 'Since I began implementing water harvesting technologies on my farm, I have managed to control soil erosion.'

Advantage	No.	%
Affordable	30	26.3
Easy to maintain	63	55.3
Require less labour	21	18.4
Grand Total	114	100

Table 3: Advantages of the Farm Technologies Used for Water Harvesting
N=114

The disadvantages raised by respondents were: High costs associated with procuring and installing the technologies 39 (34.2%), frequency maintenances 37 (32.5%) and vulnerable to floods 21 (18.4%) as well as labour intensive 17 (14.9%).

5. Discussion

The study findings showed that most of the respondents had learned about the rainwater harvesting technologies for farm use and domestic use through their neighbours, local health centres, being informed by the public health officer, educated from a local seminar attended, workshops, conferences, training, field trips, and exposure visits.

Information from the study confirmed the sources of knowledge for rainwater harvesting techniques to include; Information on Rainwater harvesting gotten from seminars, from neighbours, past experience, agricultural extension officers, learning from internets, radios, chief's baraza, agricultural shows. It was reported that some farmers too learned about rainwater harvesting from study tours where they visit other places.

The study reports the following factors that promoted the use rainwater harvesting technologies; Majority of those interviewed cited presence of iron roof in their homestead as number one factor, informal groups that enable most of the respondents to purchase tanks and too, working as team to make terraces on their farms. The study findings also show that most respondents were influenced to adopt water harvesting technologies in their farms after hearing about its long term benefit from those practicing the technology. For instance, labour requirements which were affordable and desire to increase food production.

The study also noted that most of the farmers from the study area had received water tanks as donations from the NGOs i.e., Compassion International, an organization that supports the needy children in the area.

The study found out that rainwater harvested for domestic use was clean for direct consumption, felt that using the technology presented no direct cost implication, and that roof water catchment requires fewer efforts to procure. Also, household members spend most of their time doing other important activities, Children have more time to study and play since they do not fetch water in far way places. It was noted that those who have adopted the RWHT have an added advantage of selling water to other non-adopters or to those who harvest in little amount. Also, the study reports increased farm harvests, improved food security and that water harvesting technologies have increased their income earned from the farm production. In addition, there is increased soil fertility, reduced soil erosion and water accessed throughout the year.

From the findings of the study, it was reported that rainwater harvested may at time get contaminated from the dusty roofs, others said that the technique is expensive to install and maintain and some lack of storage facilities. The technologies require high initial input and therefore may be a problem to the families that are extremely poor, nomadic, or headed by women. The study too outlined the following challenges of rainwater harvesting; Topography of the land as some lands may not allow terracing, lack of enough funds, some earth dams are contaminated for domestic use and the type soil as some soils are poorly drained and not able to hold water. He also noted the problem of poor extension services whereby the communities are not well trained on RWH technologies and recommends more sensitization, capacity building and availing the necessary technical persons to the study area.

Finally, the research found out that the RWH technologies on the farm are vulnerable to physical harm such as floods that cause soil erosion, collapses stone bunds, and as well destroying terracing. Also, the techniques are expensive to install and required much labour.

6. Conclusion

Rainwater harvesting is essential for households both in rural and urban areas of Kenya. Some of the aspects that contribute to the adoption and utilization of rainwater harvesting technologies include Knowledge available about RWH and some of the benefits that are as the result of adoption. Water harvested is used for irrigation, for livestock, cooking, drinking, washing and too sold to non-harvesters or those that harvest less. Availability of capital and labor too contribute to the implementation of rainwater harvesting technologies for farm and for household use. In the study area, education on various methods of RWH is encouraged so as to ensure that the community embraces the new ways of farming hence increase crop production and food security.

7. Recommendations

- The study recommends for more education and training of farmers on modern technologies of rainwater harvesting for farms in the study area.
- The study also recommends for emphasis on community mobilization and sensitization about rainwater technologies and sponsorship on water tanks
- There is a need to emphasize on more contact with Agricultural Extensionists in the study area. At least the farmers to interact with the experts at the village level
- The research further recommends the value chain analysis of crop production to be undertaken.

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