

Rain Water Harvesting for Enhanced Household Water, Food and Nutritional Security: Case Study of Kitui West, Lower Yatta and Matinyani Districts, Kenya

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Abstract

In semi-arid areas of Kenya, over dependence on agriculture, low and unreliable rainfall and high livestock numbers, justify the considerations of rainwater harvesting for agricultural production. A step by step is now taken by the respective government agencies and non-governmental organizations to promote rainwater harvesting, as well as promoting it to the public. This study conducted a focused evaluation of the residents' experience towards the effectiveness of rainwater harvesting system in the context of minimizing the environmental problems, the benefits associated with rainwater harvesting, the implementation issue in relation to rainwater harvesting and adoption of greenhouse technology as a paradigm shift from open field cultivation. Research was conducted among 387 respondents: 109 in Kitui West, 104 in Matinyani and 124 in Lower Yatta districts of Kitui County, Kenya. The methodology adopted used semi-structured questionnaire survey and the data was analyzed using the SPSS. The study revealed that 56.3 % of the families are female-headed while 43.7% are male headed. Agriculture is a common practice in the study area because 90.4 % of the respondents had above ½ of their lands utilized. However, it is practiced using traditional farm implements such as hoes and simple harvesting implements as affirmed by 46.3 % of the respondents. It was found that water pans are the main sources of water in the area with only 67.2 % able to access it. However, only 55.2 % of the households could access water of above 200 liters on a daily basis and owing to the average family size of 4-6 members in the study area. The use of greenhouse technology is not popular because only 11.3 % of the respondents owned greenhouses while 85.8 % of the respondents said they wanted to own greenhouses. Surprisingly, those who own greenhouse have never made money from this technology.

Keywords: Rainwater harvesting, semi-arid areas, greenhouse technology, food security, respondents

1. Introduction

Kenya is an agricultural country that relies on its land and water resources to meet the needs of its rapidly increasing population. In the arid and semi arid areas of Kenya, insufficient water for household use and for crop and livestock production has been the major constraint to rural development. Kiziloglu *et al.* (2008) argued that water is the main factor limiting agricultural production in the hot and dry summer period of semi-arid regions. Basically, water is the lifeline of any society because it enhances the environment, increases food security and ensures sustainable development, (Hatibu & Mahoo, 1999; UN-HABITAT, 2005). However, the recent droughts have highlighted the risks to human beings and livestock, which occur when rains falter or fail. As the water resources of the world decrease, and competition for a better portion of the fresh water by irrigated agriculture, domestic, industries, and environmental habitats gets stiffer, several suggestions are being made by water and irrigation stakeholders on how irrigated agriculture can maximize production with minimum water so as to release water for other water users, (Igbadun *et al.*, 2008; Jothiprakash & Sathe, 2009). There is now increasing interest in the low cost alternative generally referred to as water harvesting. Borthakur, (2008) cited that appropriate or indigenous technology can become handy in collecting and storing rain water. These technologies include either roofs or specifically prepared and protected areas on the ground can function as catchment areas.

In simple terms, rainwater harvesting is a widely used term covering all those techniques whereby rain is intercepted and used "close" to where it first reaches the earth, (Hatibu & Mahoo, 2000). By convention, rainwater harvesting is the direct collection of rainwater from roof surfaces and other purpose built catchments, the collection of sheet runoff from man-made ground or natural surface catchments and rock catchments for

domestic, industry, agriculture and environment use. According to Dean *et al.* (2012), rainwater harvesting is a well-established practice in many parts of the world and when applied in the right environment it can provide a convenient, inexpensive and sustainable source of potable water. In principle, rainwater harvesting is a simple low-cost technique which requires little specific expertise or knowledge and indeed it offers many potential benefits, (Otti & Ezenwaji, 2013). This study conducted a focused evaluation of the residents' experience towards the effectiveness of rainwater harvesting system in the context of minimizing the environmental problems, the benefits associated with rainwater harvesting, the implementation issue in relation to rainwater harvesting and adoption of greenhouse farming technology as a paradigm shift from open field cultivation.

2. MATERIALS AND METHODS

2.1. Study Site

Kitui County which was the study area is one of the counties located in the eastern parts of the Kenya and lies between longitudes 37 °45' and 39 °0' East and latitudes 0 °3.7' and 3 °0' South (Fig. 1). It is located in the semi arid parts of the Kenya which are mainly lowlands with an average altitude of between 400 and 1800 metres above the sea level. According to Luvai *et al.* (2014), the climate of the county is arid and semi-arid with very erratic and unreliable rainfall. Rainfall ranges from 500 to 1050 mm per annum while temperatures range from 14 °C to 34 °C. The long rains occur in April/May and the short rains in November/December. The periods falling between June to September and January to March are usually dry. The soils in the county are reddish sandy clay loam with good infiltration and loose structure. The county is composed of eleven districts namely: Kitui central, Kitui West, Kyuso, Mutha, Kisasi, Katulani, Lower Yatta, Matinyani, Ikutha, Mutomo and Mwingi. To the eastern side of the county, the main relief feature is the Yatta Plateau, which stretches from the north to the south between the two main rivers Athi and Tana. The plateau is almost plain with wide shallow spaced valleys.

2.2. Subjects and Procedure

The study was carried out in Matinyani, Kitui West and Lower Yatta districts all representing the semi-arid regions of Kitui County where water scarcity is perceived as a major challenge to agricultural production all which were randomly selected. The survey was undertaken in order to provide specific information on perceptions towards rainwater harvesting and greenhouse farming for enhanced food security employed in Kitui County. The research was conducted among 387 respondents from the three selected districts with 104 from Matinyani, 159 from Kitui West and 124 from Lower Yatta respectively. The data collection was carried out using a set of semi-structured questionnaires in order to capture various key parameters which greatly influence water, food and nutritional security. These parameters included respondents' profile, agricultural practice, water availability and utilization, hygiene, nutrition and food security, and greenhouse technology. The data collected included quantitative parameters and were quantified and input as nominal data into the Statistical Package for Social Science (SPSS) and Excel analytical packages and the results presented through simple descriptive statistics.

3. RESULTS AND DISCUSSIONS

3.1. Respondents Profile

Analysis of data indicates that 56.3 % of the families are female-headed while 43.7% are male headed. The study established that most households are female-headed because men had relocated to towns and cities in search of a source of earning a living since farming in the dry areas could not sustain their families. The distribution of education levels of the respondents shows that 44.6 % have only attained primary school education with those attaining secondary education as 24.6 %.

Majority of respondents aged between 31- 40 years which contributes to 31.0 % of the total respondents. This was an indication that the population is characterized with young people which raises the obvious implication in the underutilization of human resources. Going by the three pillars of the Green Revolution namely; maximization of time, maximization of space and use of appropriate technology, energy and time have been underutilized with the young men and women who have to swing to action only when it is about to rain or when it rains. In terms of family size, 67.6% of respondents had 4 – 6 members. The high numbers of members per family are mainly young people and this definitely is an indication of a high demand of resources to sustain big families in the area.

3.2. Agricultural Practice

Agriculture in the study area depends mainly on the use of traditional farm implements such as hoes and simple harvesting implements as affirmed by 46.3 % of the respondents. This is an indication of low mechanization which definitely is associated with low productivity. The limited number of advanced and high tech farm implements may also be as a result of lack of capital. The study revealed that majority of the respondents (41.9 %) in the area own large farms mainly above 4 acres. Majority of the respondents were optimistic that food and nutritional security could only be met if land was put under maximum use. Land leasing is not a common

practice in the Kitui County because 78.3 % of the respondents have never leased in any land. The obvious implication here is that the people have not developed a need to invest in extra land beyond that which they own. It was noted that 90.4 % of the respondents had above ½ of their lands utilized a sure indication of non conformity to the green revolution pillar of maximization of space. The lack of maximization of space is attributed to poverty, lack of technical knowhow and harsh climatic conditions.

3.3. Water Availability and Utilization

The main sources of water in the area include: personal boreholes, community boreholes, rivers, water pans and harvested water but rivers and water pans are the main sources of water in the area with only 67.2 % able to access it. However, personal boreholes are very rare in the area with only 3.4 % of the respondents possessing them. The general lack of piped water is an indication of very low initiative to have personal sources of water. Further, 81.6 % of the respondents do not have access to community boreholes. The practice of harvesting of rainwater is a strong indication of an expressed need in the area with 82.2 % of the respondents able to harvest it whenever it rains. Water access from kiosks is very rare because 80.6 % of the respondents did not show access indicating that only those who can afford it buy it. Similarly, 97.4 % of the respondents do not access water from hawkers and this again can be explained by the fact that hawkers sale their water.

Figure 4 shows that 55.2 % of the households who could access water of above 200 liters on a daily basis. Given that the average family size in the study area is 4-6 members, these findings agree with those by UNDP (2006) that in Kenya the average water use per person per day is below 75 liters. Given the scarcity of water in the area, it is evident that very little of that is utilized in the farm. In total 71.0 % of all the respondents use water for domestic purposes only, while 24.8% use it for domestic and farm while 4.2% for farm only.

In the context of water quality, 76.7 % of the respondents believe that water available to them is fit for human consumption. Such conclusion could be attributed to two major facts: One that the residents have never experienced serious adverse effects from the water they consume. Two that if there have been any serious water related disease outbreaks, then the residents have not associated the diseases with the water they consume. 73.9% of the respondents are of the view that the water was inadequate but 61.4 % of them belief that harvesting rain water will very much improve their lives.

3.4. Nutrition and Food Security

The study showed that majority of the households (60.3 %) depended on their farms for food while 39.0 % purchased their foods from market. Vegetables, pulses, legumes and cereals are the highest food consumed daily while fish, sea food and meat were least consumed. Food shortage is very common with 98.4 % of the respondents experiencing food shortage in the year 2010/2011. A dry period was experienced during the two planting seasons in 2010, which led to a severe food shortage in the period between 2010 and 2011. In the event, 96.8 % of the respondents said that drought caused them food shortage while only 0.8 % attributed it to lack of farm implements. Interestingly, no respondents experienced food shortage because of floods or pests and diseases. Majority of the people over-rely on rain fed farming which fails almost completely in case of drought.

3.5. Greenhouse Technology

The study showed that 73.7 % of the respondents know what a greenhouse is, while only 26.3 % do not know. In this regard therefore, only 11.3 % of the respondents owned a greenhouse while 88.7 % did not. It was noted from the study that 85.8 % of the respondents pointed out that they would like to own a green house. However, out of 11.3 % of the respondents who owned greenhouses, none of them has ever made money from them. The main reason contributing to zero returns from the greenhouses was lack of the skills on how to use them to make money. Further, the greenhouses do not meet the required standards thus gives very low yields. Majority of the respondents (94.4%) were willing to recommend a greenhouse for others while 5.6 % of them will not recommend a greenhouse for others.

4. CONCLUSIONS

Rainwater harvesting has been a worldwide accepted culture, developed by people to conserve rainwater particularly in developing and underdeveloped economies where governments cannot provide adequate quantities of public water supply. Various rainwater harvesting methods are available in literature. However, each method is site specific and demand specific. Rainwater harvesting systems depends on the topography, land use pattern, rainfall, demand pattern and economic status of the stake holder and therefore each structure requires detailed analysis of hydrology (rainfall and demand), topography and other aspects. It was found that there is a significant use of water conservation and harvesting for crop production by farmers in Kitui County and it has been evident that where water harvesting has been adopted for crop production, there has been increased farmers' income and poverty reduction. Hence, farmers see water harvesting as part of the solution to enhancing their food security. It is therefore important that more trainings and support programmes be increased in Kitui County in order to combat rising food insecurity. Development strategies point out that growing interest in modern water harvesting systems will give a big boost to people's empowerment for ending rural poverty and speed up the process of development in all its manifestations. As things stand now, Kitui County can end its

nagging water famine by investing time, money and energy on reviving the local water harvesting, soil conserving structures in addition to improving environment through better vegetation. Therefore, improvement of the existing rain water harvesting techniques which are already practiced will be of great advantages to the farmers and can also promote wide adaptability. Further, the adoption of greenhouse technology will encourage rain water harvesting for enhanced household water, food and nutritional security.

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Table 1: Respondents' distribution by family head, education and family size

	Distributions	Respondents (%)	Total (%)
Family head	Male-headed	43.7	100
	Female-headed	56.3	
Education	Illiterate	13.7	100
	Semi-illiterate	7.3	
	Primary	44.6	
	Secondary	24.6	
	College	9.8	

Table 1 outlines the distribution of family head, education and family size of the respondents

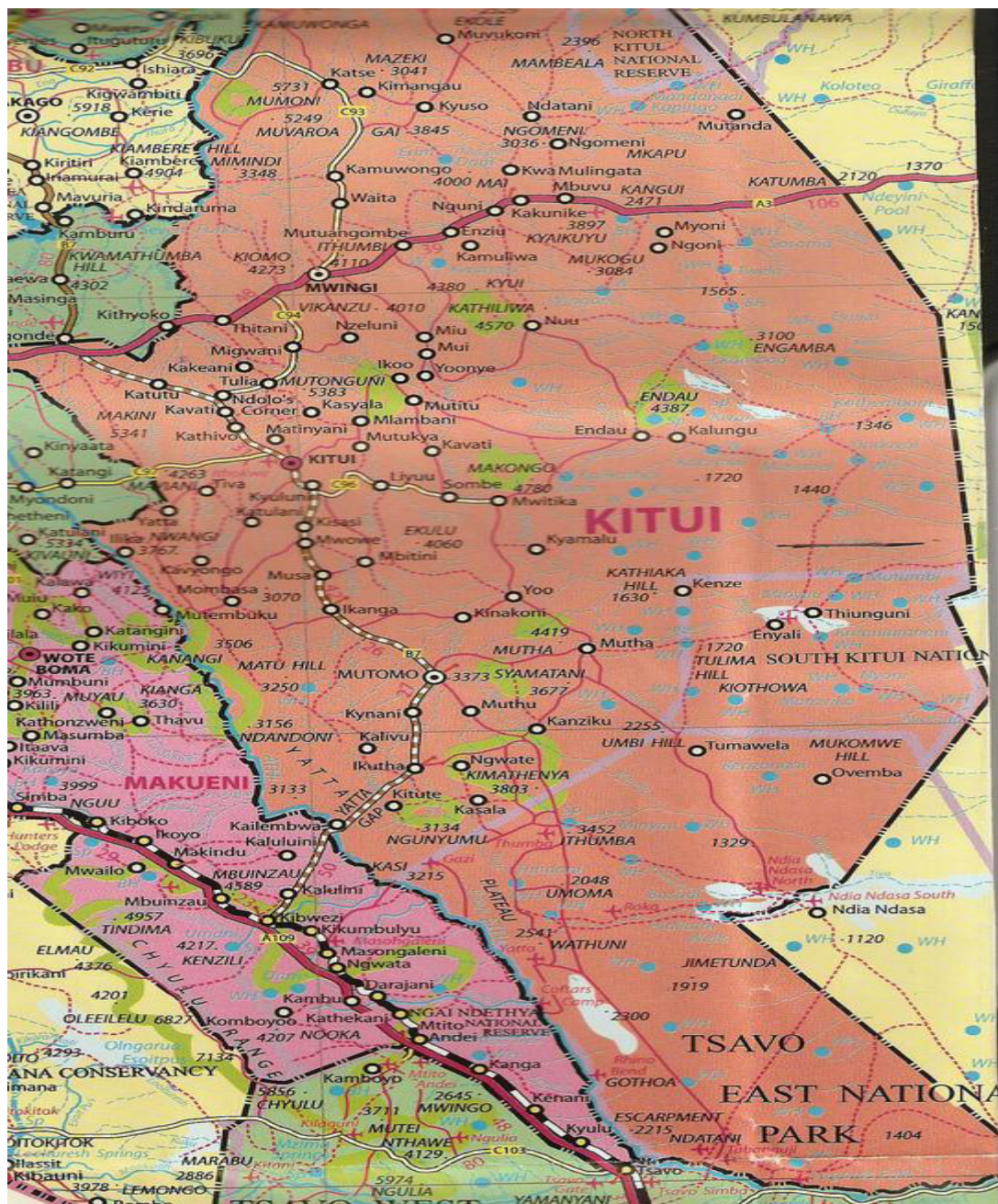


Figure 1: Map of Kitui County

Figure 1 shows the location of Kitui County, Kenya where the study was conducted

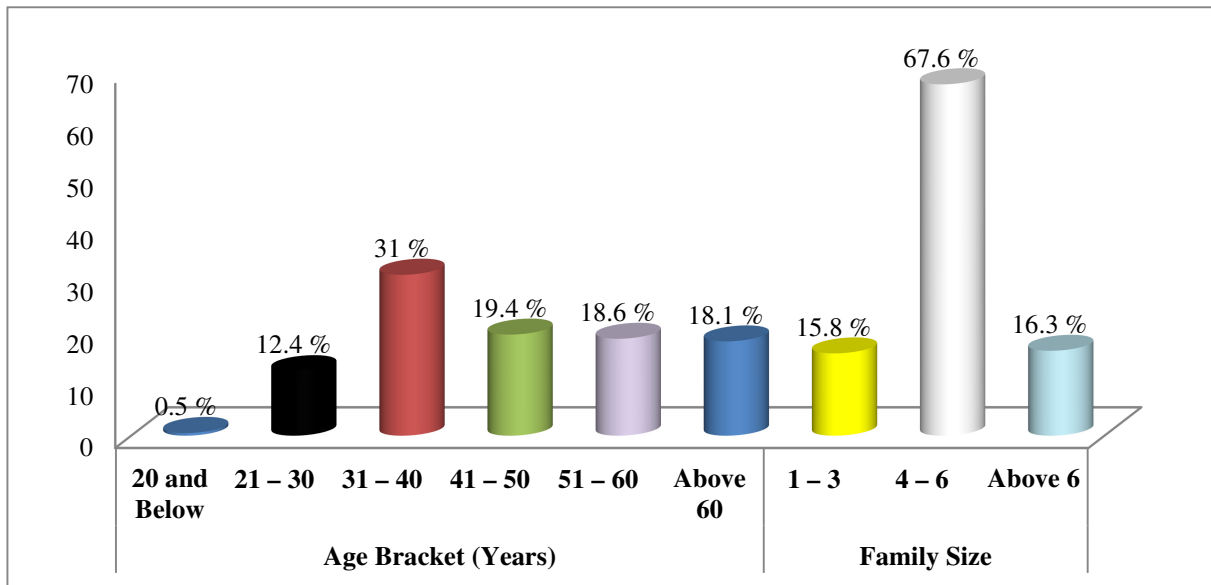


Figure 2: Respondent's distribution by age and family size
 Figure 2 compares the age distribution and family size of the respondents interviewed during the study

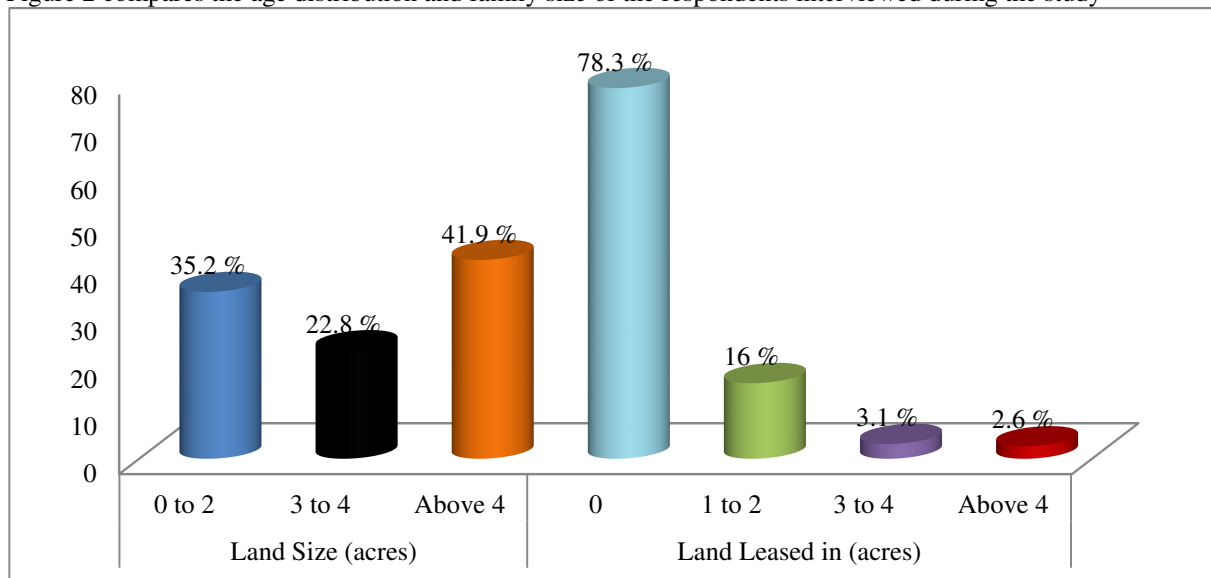


Figure 3: Land Ownership and Land Leased in
 Figure 3 outlines the sizes of land owned and leased by the respondents within the project area

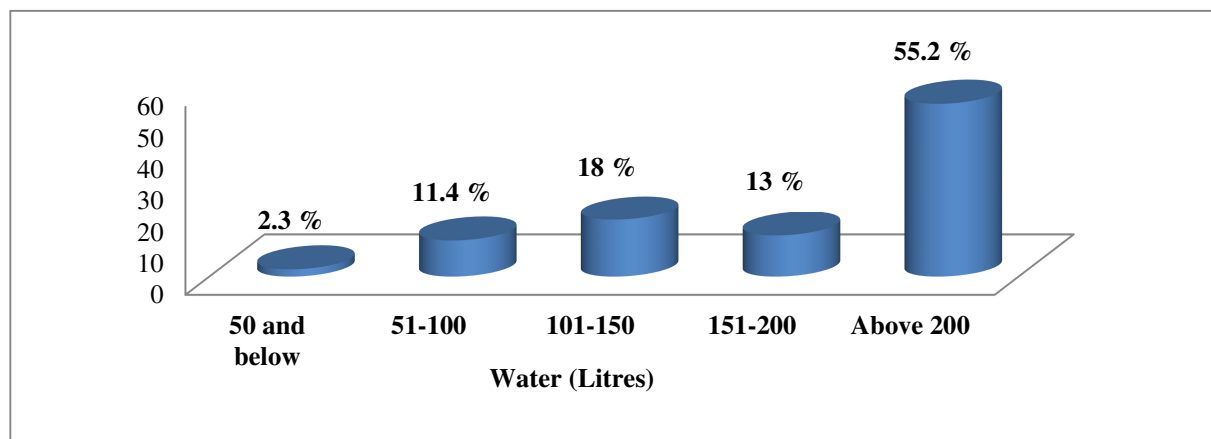


Figure 4: Total amount of water available to the respondents
 Figure 4 outlines the amount of water in litres available to the respondents per day

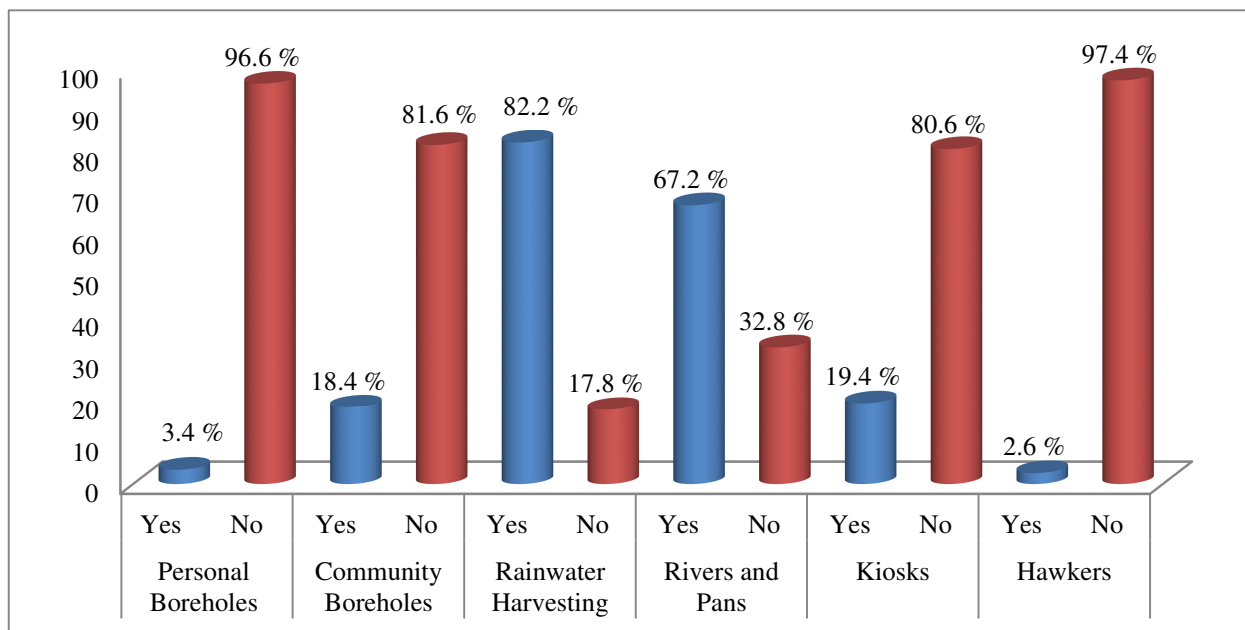


Figure 5: Water Availability and Utilization

Figure 5 outlines the various sources of water available to the respondents in addition to the levels of utilization

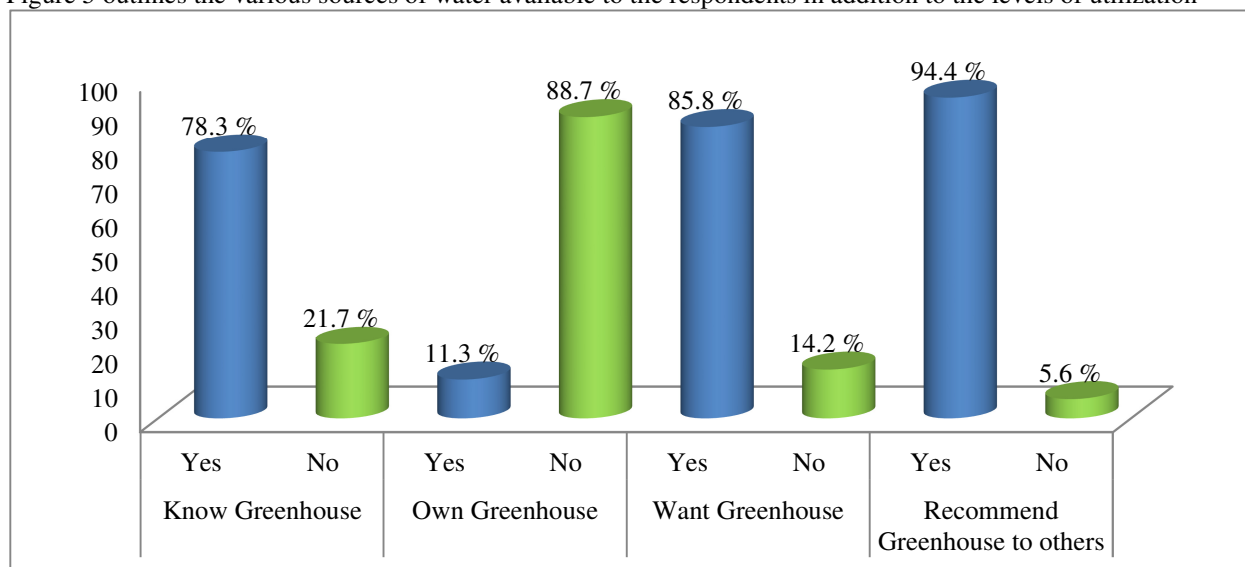


Figure 6: Response regarding greenhouse farming

Figure 6 outlines the respondents' perceptions towards greenhouse farming in Kitui County

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