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Socio-Economic Factors Affecting Water Use in Lower Thiba Sub-Catchment, Kirinyaga County, Kenya

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Abstract

Human related activities affect how water is used. However, there is limited information on the effect of socio-economic factors on water use. This study was to establish the socio-economic factors that affect water resource use in Lower Thiba Sub-Catchment using a descriptive survey design. Qualitative as well as quantitative data was collected from 361 households and 5 focus group discussions (n=366) across the Sub-catchment. The sub-catchment was sub-divided into three zones namely; upper zone, middle zone and lower zone, from where each zone, 120 respondents were randomly sampled and issued with a questionnaire. Data was analysed with the help of Statistical Package for Social Sciences (SPSS) at a statistical significance of 5% probability level. Data was then presented using descriptive statistics such as tables, graphs and test for significance was done using Chi-square. The results showed that men were more likely to do irrigation farming than women, with 81%, as compared to their female counterparts who had 68%. Most of the respondents (82%) earned between Kshs. 10,000 (87$) and 30,000 (261$) from different occupations; however, 4% of respondents, all of who were farmers earned over kshs 70,000(609$) a month, compared to other types of occupation, indicating it as the main economic activity in the area. The results showed that 57.9% of respondents who had tertiary education preferred formal employment over farming with only 9.9% of them choosing to be farmers. The results also showed 75% of the respondents who owned land were male, with only 25% of the female respondents owning land. Further, respondents in formal employment had a higher ownership (83.9%) of water harvesting facilities compared to those doing irrigation farming at 73%. The results indicate that the community socioeconomic factors within the LTS should be considered by policy makers, as they clearly affect water use within the sub-catchment.

Keywords: *Demographics; socio-economic; water-use; Lower Thiba; sub-catchment*

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Introduction

Kenya is considered a water scarce country. Demand for water is expected to rise, attributable to population growth, growing demand from irrigated agriculture, industries, and hydropower. The World Bank in a study done in year 2009, estimates that climate variability and degradation of water resources cost Kenya at least 3.3 billion Kenyan shillings (Ksh) annually (World Bank, 2009). Water is used for many different purposes throughout our economies and natural ecosystems. Agriculture is the largest consumer of water used by humans world-wide. Use of water worldwide for irrigated agriculture has been estimated to be nearly 85% of total human consumptive use. This water is vital for the production of food. FAO estimates that around 270 million hectares of land were irrigated worldwide in year 2000, which is 18% of total cropland (FAO, 2002). Around 40% of all agricultural production comes from these irrigated areas (Kanda and Lutta, 2022). As a result, evaluations of water use must pay particular attention to this sector. Rapid human population growth, harsh climatic conditions as a result of global climate change and land cover depletion due to competing land use changes have increased over the years and made water use and conservation rather complex, resulting in a greater recognition of environmental, social and economic stressors on water systems (Coultera *et al.,* 2019). Water is now recognized as a community resource and hence a common good, but on the other hand it's a necessary economic commodity and private good; further, it is inspired by cultural values and plays a role in the social life of the communities (Gleick, 1998). Several aspects determine the adequacy of water resource; besides actual physical water stress, economic and social water stress can be experienced if access to the resource is limited. Social-economic factors such as growing urbanization especially in developing countries, are also a major cause of water shortage, mainly due to a growing demand from electricity generation, manufacturing, urban agriculture, sewerage use and other residential use (Mulwa *et al.,* 2021; Robia *et al.,* 2020). Water demand increases with growth in population and rise in income levels, education levels, increasing consumer lifestyle changes and changing climate that interferes with normal farming cycles (Rogers, 2008; WWAP, 2015). Water scarcity impedes development, provokes conflicts and has adverse implications on human and ecosystem health (Hulme, *et al.,* 2001). In Kenya, studies have been done on how socio-economic factors affect water quality (Robert and Mbaka, 2021) and their effect on irrigation farmer's adoption attitudes to water management options (Mitema *et al.,* 2017; Muthui, 2015), as well as urbanization and climate change (Mulwa *et al.,* 2021). However, there is a scarcity of information on the relationship between socio-economic factors and water use. Socio-economic factors such as gender, education attainment, income and land ownership could be utilized as indicators of the impact of human-related stressors in freshwater ecosystems (Farzin *et al.,* 2013; Khan *et al.,* 2017; Islam *et al.,* 2018). In lower Thiba sub-catchment, water resource conflicts are becoming regular especially during the water scarce seasons (Lower Thiba WRUA SCMP, 2012). Water demand has increased over the years due to various economic and societal development activities (urbanization) within the sub-catchment. This study sought to examine the current socio- economic factors that could possibly be affecting how water resource is used in Lower Thiba Sub-catchment. The theoretical framework of the study was based on access theory as presented by Ribot and Peluso (2003). The theory stipulates factors that would lead to access of common resources such as water resource, where those who are endowed in one way or the other will always have an advantage, in-terms of accessing the common resource.

Materials and methods

Study Site

The study was conducted at Lower Thiba Sub-catchment located in Mwea Sub-county in Kirinyaga County. Mwea Sub-county is located on latitude 37°37'E and 0°50'S, and it occupies the lower altitude zone of the county in an expansive low-lying savannah ecosystem (Figure 1). The area was chosen as its main industry is irrigated agriculture with Mwea Irrigation Scheme which produces 80% of Kenya's rice production, as a key irrigation scheme. However, there are other small-scale farmers who depend on the river water for horticulture farming that involves production of French beans, tomatoes, water melons, onions and passion fruits, among other crops (Mburu, 2013). Water for irrigation consists of 70% water use in the area and hence the need to find out the impact of community socio-economic factors on water use.

Research design

The study used a descriptive survey design and research questions guiding the study included both qualitative and quantitative information. This study targeted community members within Lower Thiba sub-catchment and those surrounding the sub-catchment up to a 5km radius. The sub-catchment was divided into 3 sections for purposes of sampling; upper, middle, and lower zones comprising (Kutus/Kimbimbi area, Ngurubani/Karira area and Ndindiruku/Makima area respectively). These were randomly sampled proportionately based on the population of each zone to ensure each zone produced a representative sample of at least 120 respondents (inclusive of key informants' interviews and focus group discussions) as per the sample size required. Members and officials of the community's main water user association (RWATHIBA WRUA) and members / officials of irrigation water users' association (IWUA) in the irrigation scheme were purposively sampled and interviewed.

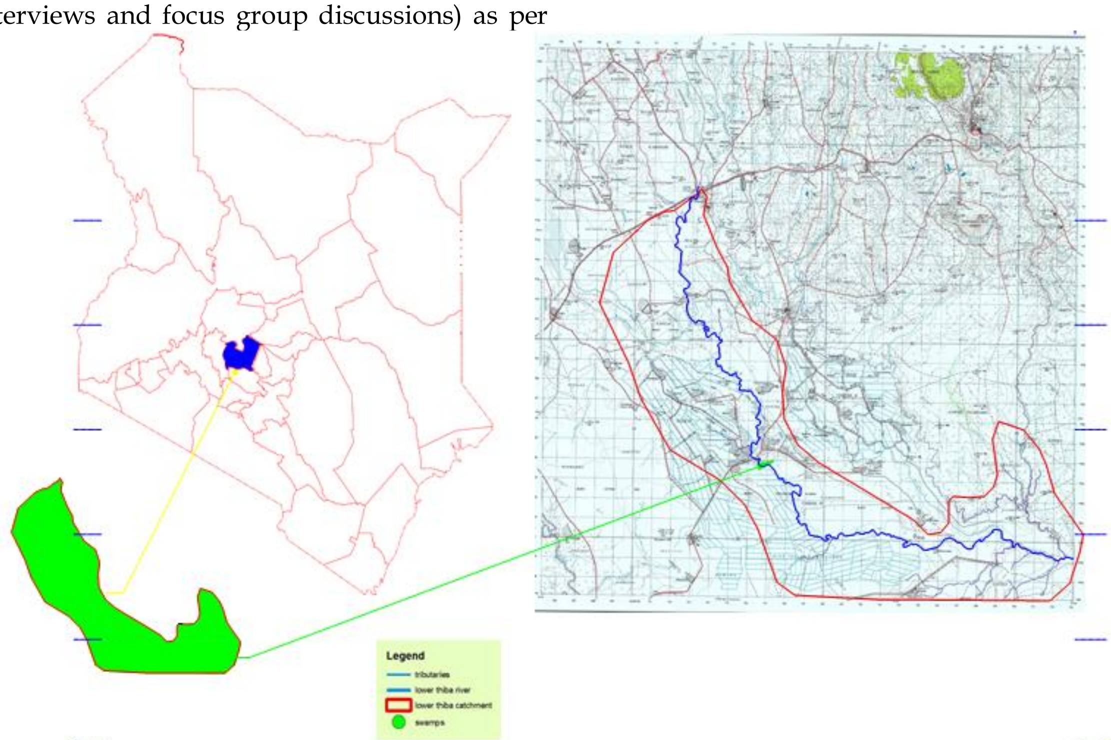

Figure 1. A Map of Lower Thiba Sub-Catchment

A sample of 361 respondents was arrived at through Yamane's (1967) formula to calculate sample sizes, which was used;

$$n = \frac{N}{1+N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision (0.05), A 95% confidence level and P (variability level) = .5 are assumed; a household population of 33,875 was used and an average household size of (6) six was used as per the census findings of year 2009 since data for this study was collected in year 2018, before the ensuing census was conducted (KNBS, 2009), (data on the number of households was gotten from the Water Resources Authority (WRA) records and the Sub-catchment management plans).

Data collection

Primary survey data was collected using semi-structured questionnaires and interview schedules, which were administered with the help of enumerators who were selected and trained. They were equipped with knowledge about the subject matter to enable them to conduct the survey successfully. A total of 361 sampled respondents and five (5) focus group discussions participated in the survey in all the three zones. Before data collection, the data collection instruments were pre-tested both for validity and reliability using a sample of 12 interview schedules administered to 12 randomly selected individuals. Questions found to be ambiguous and inadequate were modified to enhance understanding by the respondents. The information collected during the survey included social and economic demographics such as gender, age, marital status, education level, average monthly income, household size, residence period, distance to water source, sources of households' drinking /irrigation water, water quality, water quality satisfaction, and water quality issues, among other issues. Information from focus group discussions (FGD) was used to corroborate the questionnaire information provided. Direct observation and secondary data from government documents/archives; literature from both physical and electronic materials was also used.

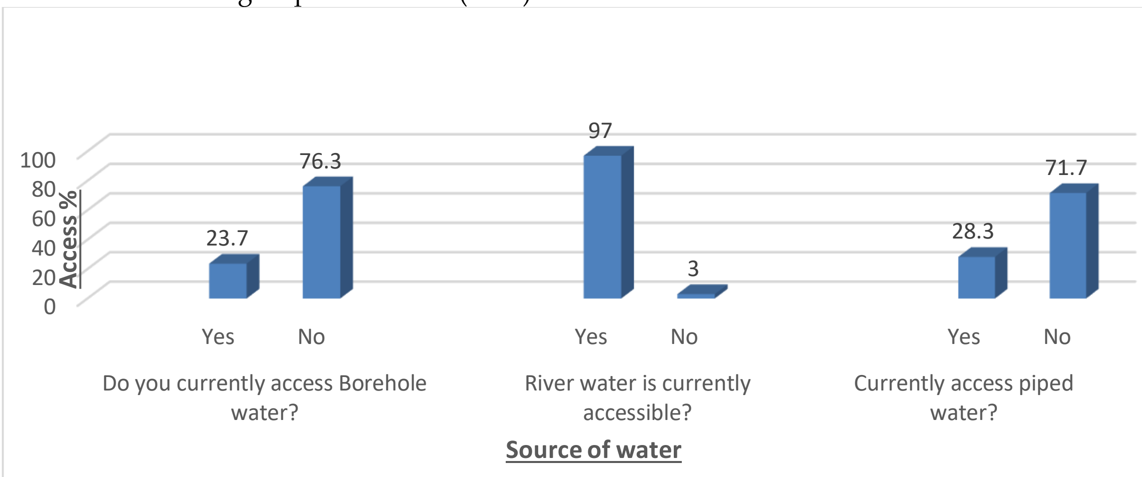

Figure 2. Community access to water sources in Lower Thiba Sub-catchment

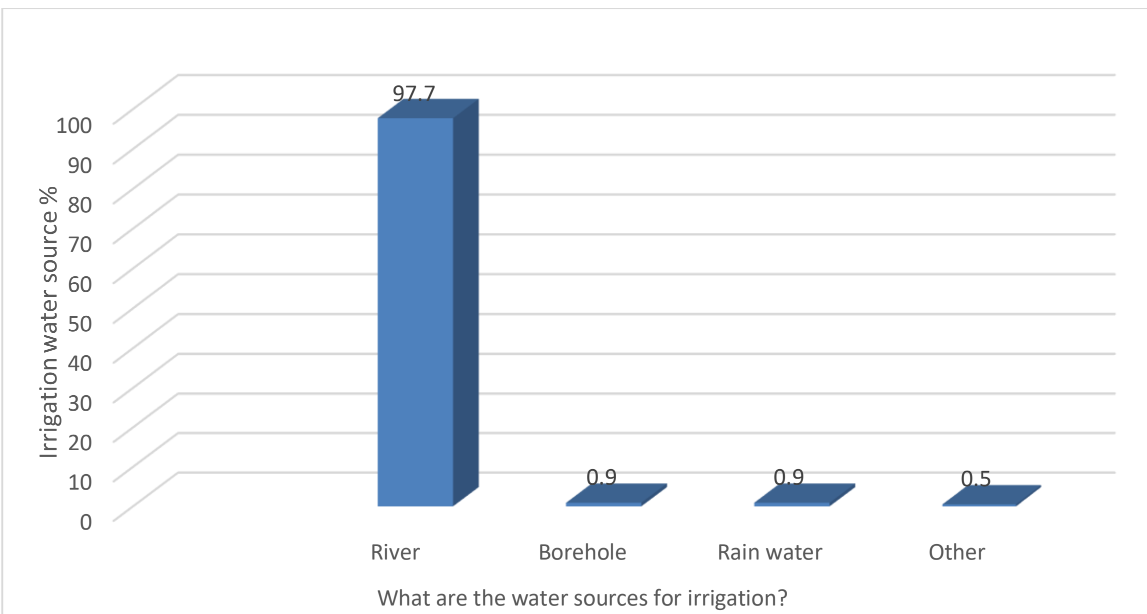

Figure 3. Sources of Irrigation Water within Lower Thiba Sub-catchment

Data analysis

The socio-economic characteristics data of the respondents were entered and coded using Microsoft excel. Data were then entered into an SPSS template from where it was analyzed using descriptive statistics such as frequencies tables, cross-tabulations, figures and percentages. To express the degree of correspondence between two variables, Chi-Square was used at a statistical significance level of 5%. The Statistical Package for Social Sciences (SPSS) version 20 was used to analyze the data.

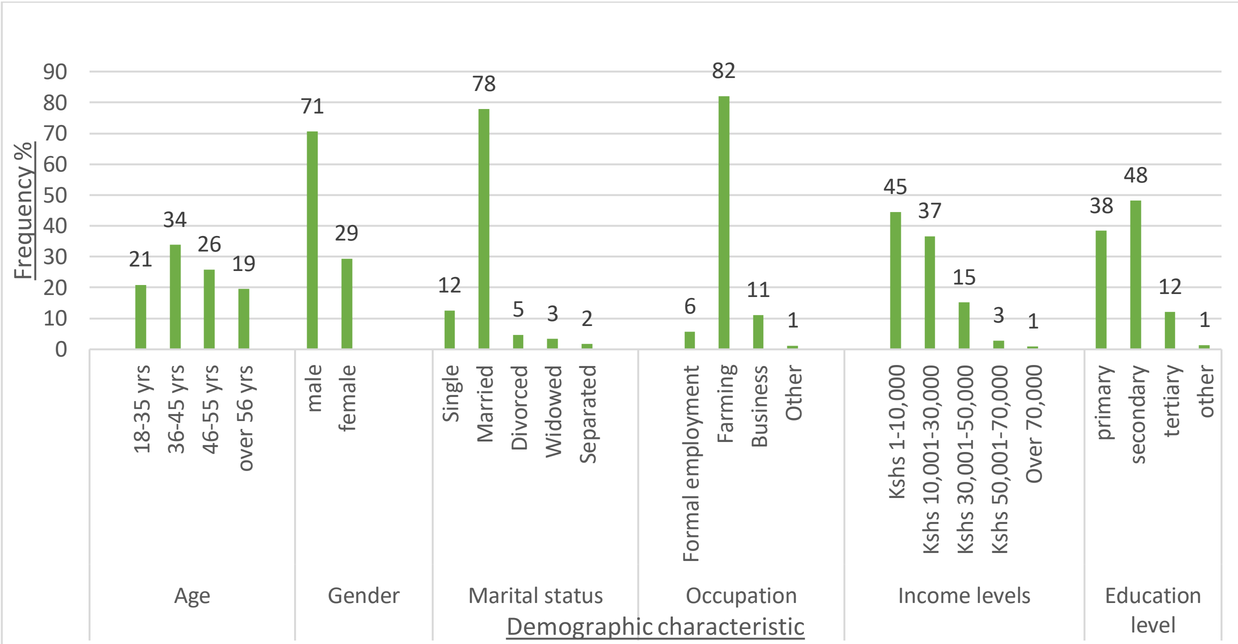

Figure 3. Demographic characteristics of the respondents sampled in the study

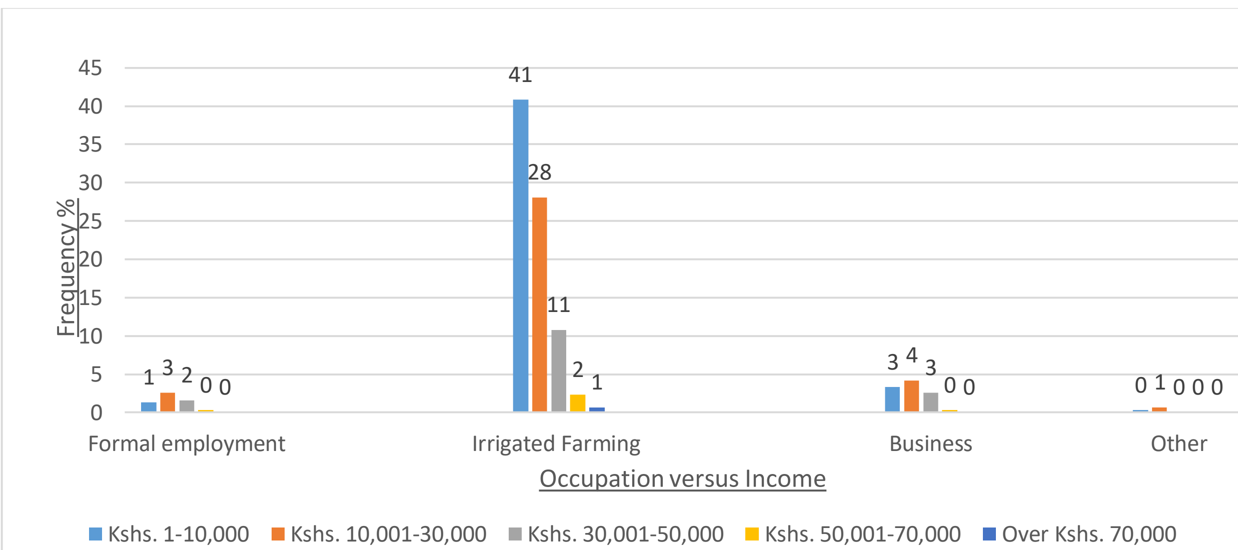

Figure 4. Income levels versus occupation type

Results

Water access and use

The results showed that out of all the respondents interviewed, access to water resource in the area was as follows; river water at 97%, Piped water at 28% and borehole water at 24% (Figure 2). This indicates that the main source of water for this area is river water as it is accessible to the majority of the population. Direct observation showed that river water was channeled through homes to farms via open unlined canals, which could lead to a lot of losses through seepage. The community uses this river water for domestic purposes too. Further, 98% of the respondents said they use river water for irrigation purposes (Figure 3).

Demographic Characteristics and Stakeholder Analysis

The demographic characteristics and stakeholder analysis of the interviewed respondents were presented in (Figure 4). There were 71% male respondents and 29% female respondents interviewed. The age of the respondents ranged from 18 years to 0ver 56 years with majority of the respondents (34%) being age 36 and 45 years. At least 78% of the respondents were married with only 12% of them being single. Most households (82%) relied on irrigated farming with only about 6% of the total number of respondents being in private sector employment. Majority of the respondents (82%) earned between Kshs, 10,000 (87$) and Kshs. 30,000(261$) every month with only 19% earning above Kshs. 30,000 (261$). Majority of the respondents (48%) had secondary education with only 12% having reached tertiary education level.

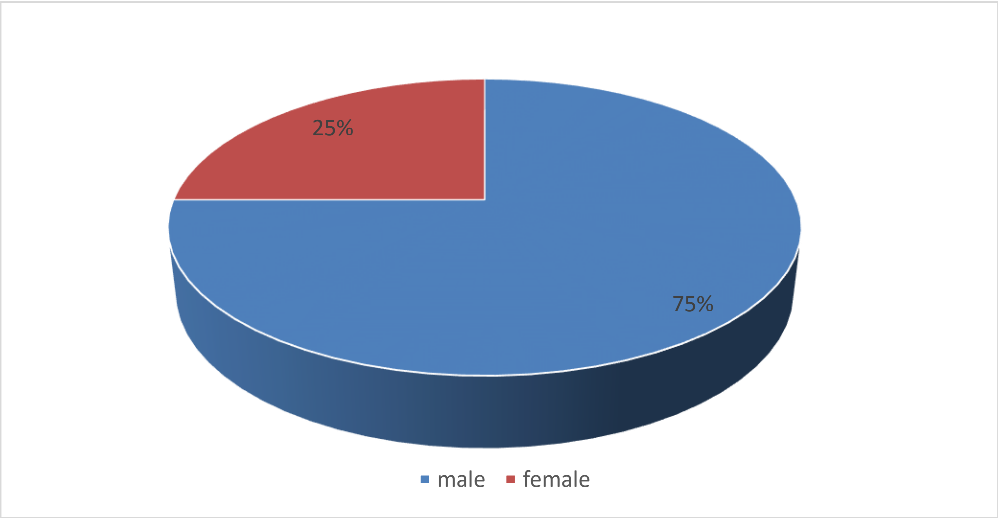

Figure 5. Landownership across the gender among the respondents

Gender Effects on occupation choice

The Results showed out of all the respondents interviewed (n=361), 82% of them were practicing irrigation farming. About 75% of the land was reported to be owned by males while the other 25% was owned by females (Figure 5). The results showed a positive correlation between gender and occupation; the probability of male persons choosing irrigation farming over other occupations was higher compared to the female persons (Table 1). There was a positive relationship between gender and occupation with 88.1% males preferring irrigation farming to other occupations compared to 68% from their female counterparts. Of all those who preferred other occupations rather than farming more female respondents at 20.4% preferred doing business as opposed to 7% of their male counterparts.

Effect of Education Level on Irrigation Water use

A majority of the respondents (86%) involved in irrigation farming had primary and secondary education levels (Table 2). There was a positive correlation between education levels and occupation. The results showed that the more one got educated, they had 24% chance of being formally employed compared to if one left at primary level (2.3%). Further, the less one is educated (primary and secondary level), there was a 92% chance that they would be farmers, as opposed to the more educated (tertiary level) who only had a 58% chance of becoming farmers.

Distribution of crops grown across the sub-catchment zones and water use

The results showed that majority of the respondents within the mid zone grew rice while those within the upper and lower zone did horticulture, fruit production, root-crops, cereals and drug crops production (Table 3). The results also indicate the most commonly grown crops across the sub-catchment are four (rice, green maize, tomatoes and French-beans). Other crops that have high water demand seem to be emerging within the sub-catchment driven by the demand from the changing urban lifestyles, especially in the upper and lower zones of the sub-catchment. These include; miraa (khat), bananas, non-leafy vegetables, fruits such as avocadoes and green maize, among many other emerging crops.

Income levels and occupation type

Majority (69%) of the respondents were in the income bracket between 10,000 (87$) -30,000 (261$) shillings a month (Figure 4)

Table 1. Effects of gender on occupation type

Occupation	Gender (%)		X^2
	Male	Female	
Formal Employment	3.0	2.7	0.000 (s)
Farming	61.3	20.8	
Business	4.8	6.2	
Other	0.6	0.6	
Total	**69.6**	**30.4**	

(s) = there is a significant relationship between gender and occupation

Table 2. Effect of education level on Occupation choice

Education Level	Job occupation					
	Formal employment %	Farming %	Business %	Other %	**Total**	**Chi-Square**
Primary	0.9	35.3	2.1	0.0	**38.3**	**0.000(s)**
Secondary	1.5	38.6	6.9	0.9	**47.9**	
Tertiary	3.3	8.1	2.1	0.3	13.8	
Total	**5.7**	**81.9**	**11.1**	**1.2**	**100.0**	

(s) = there is a significant relationship between education level and occupation

Income levels did not seem to significantly affect the occupation chosen though irrigation farming seemed as the income earning activity most preferred in the area at (82%), with 4% of the respondents who were all farmers earning over 70,000 (609$) shillings a month).

Table 3. Distribution of crops grown across the sub-catchment

Crops Grown by Farmers	**Project location Zone -Upper/Mid/Lower of LOWER THIBA SUB-CATCHMENT**							
	Upper		*Mid*		*Lower*		*Total*	
	Count	%	**Count**	%	**Count**	%	**Count**	%
Rice	**35**	*19.4*	**93**	*51.8*	**52**	*28.8*	**180**	*100*
Green maize	**69**	*44.5*	**27**	*17.4*	**59**	*38.1*	**155**	*100*
Water melon	**2**	*40*	**0**	*0*	**3**	*60*	**5**	*100*
Tomatoes	**52**	*43.7*	**22**	*18.5*	**45**	*37.8*	**119**	*100*
Green grams	**0**	*0*	**0**	*0*	**12**	*100*	**12**	*100*
Pawpaws	**2**	*50*	**1**	*25*	**1**	*25*	**4**	*100*
French beans	**48**	*40.3*	**29**	*24.4*	**42**	*35.3*	**119**	*100*
Miraa	**0**	*0*	**0**	*0*	**7**	*100*	**7**	*100*
Sorghum	**6**	*100*	**0**	*0*	**0**	*0*	**6**	*100*
Onions	**3**	*42.9*	**0**	*0*	**4**	*57.1*	**7**	*100*

Leafy vegetables (kales, spinach, cabbage)	7	17.5	12	30	21	52.5	40	100
Bananas	38	73.1	9	17.3	5	9.6	52	100
Soy beans	14	77.8	4	22.2	0	0	18	100
Non leafy vegs (cucumber, pepper, eggplant)	25	67.6	7	18.9	5	13.5	37	100
Millet	5	100	0	0	0	0	5	100
Sweet potatoes	17	77.3	4	18.2	1	4.5	22	100
Avocadoes	1	100	0	0	0	0	1	100
Pumpkin/butternut	5	100	0	0	0	0	5	100
Sugarcane	2	66.7	0	0	1	33.3	3	100
Potatoes	2	33.3	3	50	1	16.7	6	100
Cassava/yams	2	100	0	0	0	0	2	100
Nappier grass	2	100	0	0	0	0	2	100
Sunflower	1	100	0	0	0	0	1	100
Coffee	1	100	0	0	0	0	1	100
Mangoes	0	0	0	0	1	100	1	100

Effect of land ownership and Gender

Only 25% of the respondents who were women owned land (Figure. 5). There was a significant relationship between gender and land ownership as there were more men than women owning land. Majority (86%) of the respondents who owned land practiced irrigated farming compared to if one did not own land. However, land ownership was different across the sub-catchment as indicated in table 6.

Majority of the respondents (75.7%) owned between 0.5-2ha of land in the upper and mid zone of the sub-catchment; while in the lower sub-catchment most respondents own large pieces of land between 5 and upto 40 ha of land (Table 4). Majority of the respondents in the mid zone owned between 1 and 2 hactares of land as this is the zone where Mwea irrigation scheme is located and the average acreage is 1.6 hactares (Mburu, 2013

Table 4. Distribution of land ownership across the sub-catchment

Acreage (ha)	Project location Zone -Upper/Mid/Lower of LOWER THIBA WRUA area.		
	Upper	Mid	Lower
	Frequency	frequency	Frequency
.00	0	3	0
.20	0	1	0
.25	**2**	**6**	1
.40	0	3	0
.50	**9**	**21**	0
.75	2	3	0
1.00	**24**	**40**	**5**
1.25	0	1	0
1.50	4	7	0
2.00	**17**	**13**	**16**
2.50	0	2	0
3.00	**7**	**6**	**7**
4.00	**6**	**2**	**8**
5.00	1	0	4
6.00	1	0	4
7.00	*0*	*0*	*2*
8.00	*0*	*0*	*1*

9.00	*0*	*0*	*1*
10.00	*0*	*0*	*2*
12.00	*0*	*0*	*1*
15.00	*0*	*0*	*1*
20.00	*0*	*0*	*1*
40.00	*0*	*0*	*1*
Total	**73**	**108**	**55**

Effect of water-based assets ownership and water use

The results did show a significant relationship between ownership of water-based assets and occupation, especially in the ownership of water harvesting facilities which went up for those in formal employment compared to other occupations (Table 5). Those in formal employment had an increased tendency to own water storage and harvesting facilities at 84% as compared to those in farming who were only at 73%. This can be explained probably by the fact that farmers can easily access river water for other uses as they use it for irrigation while those in formal employment have to store own water for domestic use. The results indicated that though most of the respondents owned water storage facilities, water harvesting and storage was low at 23% (Fig.6). This can be explained to the community perception that there is surplus water hence no need to store or harvest water, due to access to the river water.

Table 5. Water-based assets ownership versus occupation type

Own Water-based Asset	Job occupation					Total %	Chi-square
		Formal employment %	Farming %	Business %	Other %		
	Yes	2.6	42.6	5.2	0.7	**51.1**	
Water pump(s)	No	3.3	39.7	5.6	0.3	**48.9**	**.862**
Water	Yes	6.1	66.7	8.0	0.6	**81.4**	
storage facilities	No	0.0	16.0	1.9	0.6	**18.6**	**.070**
Water	Yes	5.2	60.6	5.9	0.0	**71.8**	
Harvesting facilities	No	1.0	22.0	3.8	1.4	**28.2**	**.040 (s)**

Chi square values below 0.05 indicate a significant relationship between water assets ownership and occupation.
(s) = there is a significant relationship between water asset ownership and occupation

Discussion

River water access was at 97% and 98% of this river water was used for irrigation purposes. This is above the globally estimated water use for irrigation of 95% of all water withdrawals as estimated by FAO (2003). However, water access through piping is only at 28% as majority get distribution of this water using open canals abstracted from the main River Thiba. Most of the respondents indicated that they used river water for all their purposes. The Constitution of Kenya provides that access to clean water to all is a basic human right (GOK, (2010). Consequently, this data gives an opportunity for policy makers to improve domestic water access in this area by ensuring proper water infrastructure such as water piping systems and bore-hole drilling, to supplement river water in the area.

The demographic characteristics showed 60% of our respondents being between the age of 35 years- 55 years, and 78% of the respondents were married. The male respondents were 71%, probably because the study focused on interviewing the head of the household who is the decision-maker, with only 25% of the respondents being female. Only 25% of the interviewed women respondents owned land, as well as had access to water resource. It is common knowledge that women are the ones directly involved in the farms (labour) and homes, hence use water directly, but tend to be ignored when making decisions on water resource. Studies have shown that equitable involvement of both men and women in irrigated farming is key to sustainability and effectiveness (World Bank *et al.,* 2008; Forch *et al.,* 2005). Another study found out that farming was mainly dominated by men as they own the factors of production such as land, agricultural inputs, extension services and access to markets; with women's role left to providing farm labour (Upadhyay, 2004; Bikketi *et al.*, 2016; Ifejika, 2006). This shows there is a need for policy makers within the sub-catchment to consider involving both men and women in equal measures during policy and decision making in regard to water access, use and management (Were *et al.,* 2008).

The other key demographic feature that came out was the fact that 86% of the respondents were within primary and secondary level of education combined. This means that majority of the irrigation farmers have low levels of education, which could explain the low support for water conservation behaviour in the area. Studies have established that educated farmers are more efficient irrigators as they have knowledge on water management and have much easier contact with extension agents (Shantha and Bandara, 2012; Asadullah and Rahman, 2009). Sheikh *et al.,* (2014) also found out that education levels significantly affected one's participation in water management issues. On the other hand, education level is related to more awareness on environmental conservation. This could mean that more educated households understand more ways of conserving water compared to those who are less educated. In addition, educated households are able to purchase water conserving appliances and choose drought-tolerant plants for their gardens. However, some studies have refuted that theory and shown that lower educated individuals engage in more water conservation behaviour and use less water compared to their highly educated counterparts (Gregory and Di leo, 2003). Ngetich, (2019) and Fielding *et al.,* (2012) also argued that families with advanced education levels have stronger intents to preserve water but never really do, and that in real sense, households with lower education levels take part in more water conservation behaviour and use less water than educated households. This observation could indicate the need for policy makers to create more awareness on water use and management since majority of the water users have low levels of education; as well as encourage farming as a profession to the educated.

Income levels for 82% of the respondents was between Kshs. 10,000 (87$) to Kshs. 30,000 (261$) per month. However, irrigation farming contributed over 90% of this income, with 4% of the respondents who were only farmers earning up-to over Kshs. 70,000 (609$) per month. This observation could be interpreted to mean irrigated farming is a major economic activity within the sub-catchment, which really means proper water resource management within the sub-catchment is key. Previous studies noted that irrigation farming made farmers more food secure and improved their incomes as compared to dry-land farming (Oni *et al.,* 2011; Bacha *et al.,* 2011; and Brabben *et al.,* 2004). Support and policy should be driven mainly towards farmers, and especially to do with water resource use and conservation. It could also mean that diversification into other income generating activities should be encouraged in-order to manage risks that come with the challenges of irrigated farming, especially with the effects of climate change. Further, activities such as landscaped gardens which require regular watering are associated with well-to-do families. Individuals with higher income tend to be less sensitive to the cost of water as opposed to those with low income. In addition, consumer lifestyle changes, such as, increase in meat consumption, increase in consumption of water-intensive food-crops such as rice and vegetables, increased urbanization (ownership of bigger homes, increased use of motor vehicles and other water consuming appliances and entertainment features), have all led to an increase in water consumption. In addition, higher incomes could spell doom for water conservation as studies have shown that family units with higher incomes utilize more water than those with lower pay (Robert and Mbaka, 2021). Additionally, Corbella and Pujol (2009), reported that higher income levels in most cases result in an increase in living standards, which in turn enables households to purchase more water-consuming appliances. This will consequently lead to more water consumption for these high-income households as compared to the poor households. Further, as the economy grows, water demand rises. Water demand increases with income mostly due to an increased purchasing power of high-income households. This causes a change in consumption and lifestyle of such households, for instance, acquiring bigger landscaped private plots that require more water, increase in consumption of animal-based products that require more water to produce, bigger homes with more domestic water needs, use of motor vehicles that require frequent use of water for maintenance, among other changes. Also, higher income family units might be less sensitive to the cost of water, as it would represent only a smaller portion of their family income (Ringler, 2012). This study therefore projects that an increasing growth in income as well as rising living standard of a growing middle class (urbanization) may prompt sharp increments in water use which in the long run may be unsustainable. This is progressively pronounced where water resource utilization, distribution, price, and conservation is inadequately managed, such as in our study area (Lee, 2018). Consequently, this study recommends progressive public awareness on sustainable water use and conservation; and a more organized water distribution system across the sub-catchment.

Most of the respondents (75.7%) owned small pieces of land between 0.5 ha to 2.5 ha. It has been noted that small scale land owners who practice irrigated agriculture are able to increase their production and through diversifying their farming, enhance food security and increase their household farm incomes (Oni *et al.,* 2011; Bacha *et al.,* 2011). In our earlier findings it was observed that majority of our respondents were male as heads of households and 75% of them owned land as compared to their female counterparts with only 25% land ownership, which agrees with this finding that the male heads of households own factors of production, the main one being land. Consideration should be done in future to ensure equal distribution in ownership of land by both male and female headed households and hence equal access to water. Large farm owners were mainly in the lower zones of the sub-catchment, owning up-to 40 hectares of land, which represented 59% of total large land ownership across the sub-catchment.

Majority of the respondents (51.1%) owned water pumps and those who owned pumps were in the upper zone of the sub-catchment where farmers produced other crops rather than rice, which use other forms of irrigation methods requiring water to be pumped against the gravity to the farms. Liberalization of rice production has also caused a mushrooming of rice out-growers mainly in the upper and lower zones of the sub-catchment where rice is grown out of the main Mwea Rice Irrigation Scheme. Policy makers should consider having a water uses allocation policy in-order to ensure everyone accesses enough water for their use regardless of whether they have water pumps or not. This can be done using abstraction meters where one pays for the amount abstracted. This can then be rationed according to priority needs during the dry season when demand is high and supply low. Lining of canals and water piping systems would ensure efficient distribution of water to more people within the sub-catchment. Majority of the respondents (81.4%) owned water storage facilities and 71.8% owned water harvesting facilities, though very few (23%) did the actual rain water harvesting. Direct observation showed that the main water abstractor within the sub-catchment, National Irrigation Board (NIB) did not also own any water storage, water-harvesting nor water cleaning/recycling facility. Studies have shown that water harvesting and storage involved risks and investments, which the existing community and institutions would be avoiding (Fox *et al.,* 2005). However, water harvesting and storage for domestic use and for supplemental irrigation could alleviate the severity of water scarcity within the sub-catchment especially during the dry season, and increase yield as observed in previous studies elsewhere (Piemontesea *et al*., 2020).

Conclusion

The results indicate that certain demographic factors such as age, income levels, occupation, gender, and education levels are important indicators of how water as an important economic resource is accessed, used and managed in this area. Other socio-economic factors identified include; type of crops grown, land ownership and ownership of water-based assets as having an effect on water use in this area.

Recommendation

Awareness on water use and conservation needs to be enhanced in the area as the study found majority of water users were of lower education levels. Water harvesting should be encouraged as majority of the population owned water harvesting facilities, though very few did the actual harvesting and storage. On-farm water conservation should be encouraged, and policy makers need to recommend crops that are water efficient, as the study found out that there was an emergence of water intense crops across the sub-catchment. National Irrigation Board (NIB) should come up with a water cleaning facility to help recycle contaminated water from the rice farms before it is released back into the river. In addition, domestic water use demand is progressively increasing due to increasing urbanization in the area of study. The study recommends additional metered water piping for domestic use which can measure and cost water use per household. This will eventually help improve portable domestic water access in the study area. Finally, since water from River Thiba seemed to be the main source of water for all purposes in the area, further studies need to be done on the health and sustainability of this important water resource.

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