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Reinvigorating the Role of Water Kiosks in Sustaining Resilience in Rural Livelihoods During Climate Change Related Water Shortages: The case of Kisumu County, Kenya

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Abstract

The UN SDG6 has listed ensuring availability and sustainable management of water and sanitation for all, with appreciation of the water access, equitability, safety, affordability and community participation. However, accessibility and safety of water for households are affected by the climatic changes, especially during prolonged and frequent droughts. The objective of this study was to assess the role of the borehole water kiosks for sustaining resilience of community water supply during climate change-related water shortages within Kisumu County, Kenya. Data was collected from 460 households as respondents, and 3 focus group discussions (FGDs) with 36 participants distributed across three Sub-Counties of Kisumu in Kenya. The household questionnaires were administered to respondents randomly selected from 31 water kiosks extended from 9 boreholes. The generated household data was analyzed through descriptive and inferential statistics using SPSS software. Three FGDs were each undertaken in every selected Sub-County, with discussions audio-recorded, transcribed, translated and then analyzed using NVivo. The three key informant interviews were recorded, transcribed and analyzed through the NVivo software. The findings showed that many households had seasonal source-switching for livelihood water needs. For instance, 77.6% of households collected their drinking water from borehole water kiosks during dry seasons. The reasons why the households collected water from the borehole water kiosks included being the only source (45%) and or these drinking water sources were the closest to their houses (39%). Over 67% of the households reported to be collecting drinking water twice in a day from these borehole water kiosks, with a round trip of about 30 minutes. The relationships between the households' choice of water source, frequency and number of times of collecting water for livelihood and the gender of the household headship were found to be statistically significant during dry seasons. There is therefore need to undertake further investigation on the impact of climate change-related shortages on female-headed households' livelihoods and improving the conditions of service of borehole water kiosks, especially in Nyakach Sub-County.

Keywords: Climate change, water kiosk, dry seasons, households, boreholes

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Background of the Study

The UN Sustainable Development Goals' of ensuring availability and sustainable management of water and sanitation for all (SDG6) has two important targets, as identified by some authors (Ortigara et al., 2018). First, Target 6.1 requires provision for achieving universal and equitable access to safe and affordable drinking water for all. Second, Target 6b requires support and strengthening of participation of local communities in improving water and sanitation management. These two targets appreciate aspects of access to water, including universality, equitability, safety, affordability and participation (Ojha et al., 2018). The universality revolves around accessibility by all while equitability looks at the proportionate accessibility in rightful manner. As well, safety to getting water within the water quality standards and affordability is pricing which is economically feasible in the said community while ensuring participation of local communities.

However, safe drinking water, though abundantly available in some countries, remains a scarcely available communal resource in some regions worldwide (Contzen & Marks, 2018). The UN WHO and UNICEF estimated that around one in four people lacked safely managed drinking water in their homes in 2020; with more specifically 19%, representing 1.6 billion people, not able to access safely managed drinking water (WHO/UNICEF JMP, 2021). Eight out of ten of the 1.6 billion people lacking access to the safely managed drinking water live in the rural areas. For example, Kenya's access to safe water is estimated at 59% while Kisumu County's access is at 58%. While there is an above average access in the Kisumu and Kenya cases, the impact of climate change is likely to negatively affect the gains that might have been made.

Several authors have reported that above 81% of households within the Lake Victoria Basin, including Kisumu County, have some knowledge about climate change (Odwori, 2021; Ajuang et al., 2016). Some of the observable climate changes reported by these households included rising temperatures; declining rains; increased drought frequency; and changes in water sources (Ajuang et al., 2016). Other results from other authors show an increasing trend of rainfall over Kisumu, inter-annual variability of rainfall, which showed increased or decreased patterns, resulting in droughts and flooding (Masimbe, 2018). The author observed that flooding and drought impacted clean water supply, quality and use, with about 61% using alternative sources of water at any one time. Apart from the rainfall, the temperature trend during the same period showed the minimum temperatures rising faster than the maximum, indicating warming (Masimbe, 2018). As the global warming and drought become more frequent, there is increase in the driver causes for water resource conflicts, especially among women using water more frequently, multiple water users including livestock water or those who collect for sale.

Providing water security is a key dimension of livelihood sustenance in developing countries. Despite the political efforts, and economic, social and financial investments, data show that there has been only moderate progress to date, and huge inequalities appear when comparing access to water within rural or urban areas, and trends within different regions. While in many developed countries, the provision of safe, regular and adequate water services is in the purview of the national and devolved governments, it is often not the same in the developing countries. In many developing countries, water service provision in the rural areas is left to community structures while the national and devolved state actors seek to provide water for the urban and peri-urban residents. The community-managed water supplies adopt a hybrid of arrangements,

sometimes guided by the source of funding for the water system. In some instances, the funding institution may provide a greater chunk of the initial construction investment, with or without community contributions, while that community agrees to cover the post-construction expenses.

Households in rural areas frequently have to rely on multiple water sources to meet the domestic water needs. The common water sources include protected and unprotected springs, boreholes and hand dug wells, open sources (dam, lakes, rivers, pans, etc.), rain water harvesting, among others. However, sources considered safe include the protected springs, boreholes, treated water from the open source and rain harvested water. The household decision from what source to fetch water was influenced by factors such as availability, quality, reliability and or affordability (Price et al., 2019). Borehole kiosks have become more used sources of water in many rural households. However, approximately one-third of boreholes in rural sub-Saharan Africa fail within five years of construction (Kelly et al., 2017). As observed by Kelly et al. (2017), interruptions in water kiosk service may force users to revert to alternative, potentially unprotected sources. Modelled data suggest that this may undermine any health benefits provided by the safe water systems. However, such source-switching may also be driven by seasonal factors such as the climate changes (Contzen & Marks, 2018).

The purpose of this study was to assess the role of water kiosks in sustaining resilience in rural livelihood during climate change-related water shortages within Kisumu County, Kenya. The specific objectives were to establish the households safe water source-switching patterns during rainy and dry seasons; to examine the influence of the community-managed water kiosks on sustaining the rural livelihood in dry seasons; and to establish the influence and interaction of water kiosk service affect beneficiary characteristics on the resilience to the water shortages. These objectives were to facilitate answering the research question of what role the water kiosks play in sustaining resilience in rural livelihood during the climate change-related water shortages. Specifically, other questions included: In what ways do the households undertake safe water source-switching patterns during rainy and dry seasons? In what ways do the community-managed water kiosks influence sustenance of rural livelihood in dry seasons? Finally, in what ways do the influences and interactions of the water kiosk service affect beneficiary characteristics on the resilience to the water shortages?

Study Context and Methodology

Kisumu County is one of the Kenya's 47 counties, bordered by Homa Bay, Nandi, Kericho, Vihiga and Siaya Counties. The other areas are surrounded by the Lake Victoria. Compared to other neighbouring counties, Kisumu County has made a substantive effort to transform the hand-pumps water systems to solar and grid motorized water systems as provided for her County Integrated Development Plan (CIDP, 2018). This was an effort to reach out to several beneficiaries with extended and expanded kiosks beyond the borehole points of collection. In this regards, therefore, Kisumu County formed the best place to understand giving new energy to the community-managed borehole water kiosks in sustenance of household resilience during climate change-related water shortages.

Kisumu County, representing 0.36% of the total land area of Kenya, covers approximately 567 Km^2 on water and 2,086 Km^2 land area. The county is endowed with the second largest freshwater lake in the world - L. Victoria - with two major rivers; Nyando and Sondu-Miriu and seven permanent rivers (including Awach-Kano, Oroba/Ombeyi, Kibos, Awach-Seme, Kisian, and Mugruk), in its catchment. The water coverage for the county currently was estimated at 58% (County, 2018) but the water provision was not keeping up with the rapid population growth, and over half Kisumu's residents have no access to safe drinking water at all.

The study used a mixed research design method to investigate the reinvigorating the role of community-managed water kiosks for sustaining resilience of community during dry seasons within Kisumu County, Kenya. The mixed method design was relevant to this study in terms of rationale and purpose; which involved some triangulation; complementarity; development; initiation; and expansion (McKim, 2017; Combs & Onwuegbuzie, 2010). In order to identify community-managed boreholes and water service points, there was elimination and purposive selection. First, the targeted water systems were those that were community-managed, 218 water sources were listed as managed by water users' associations (WUAs) and were selected from the 292 mapped water points in 2020 within Kisumu County. Second, only those water sources that were identified as boreholes were selected in the next stage. This categorization yielded 97 water boreholes from the 218 water sources. Third, community-managed boreholes with two or more water service kiosks were selected for Nyando, Nyakach and Seme Sub-Counties. In this categorization, around 52 community-managed boreholes with 156 public water service points, 57 institutional service points and 1,738 private homestead service pointes were identified.

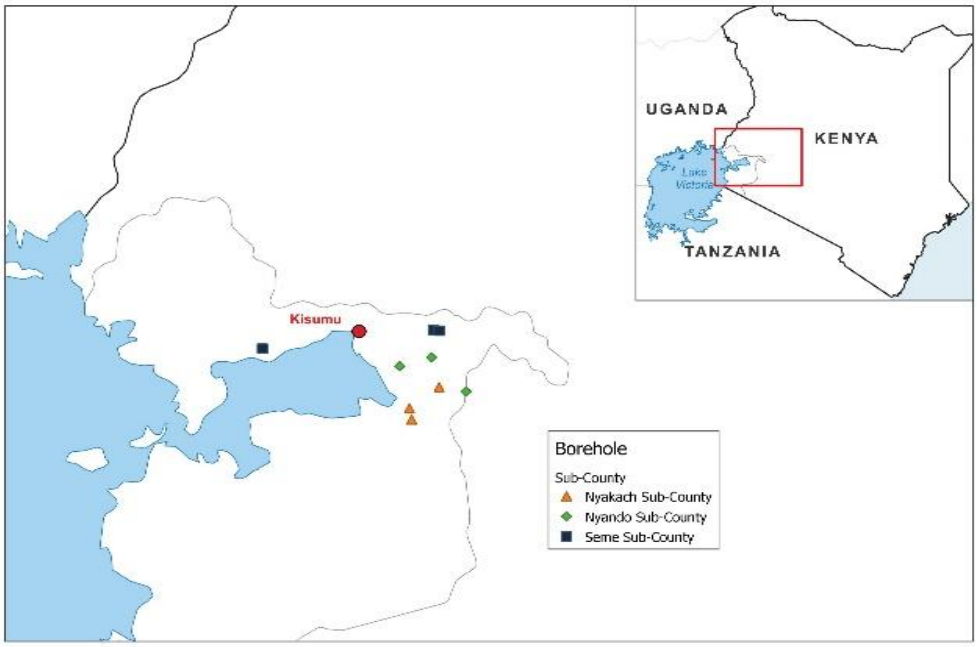


Figure 3.1: Borehole Study Sites

Applying the sampling methods used by previous researchers (Ibrahim, 2017; Masduqi, 2010), nine boreholes were purposively selected from the three sub-counties, with each Sub County having three selected boreholes with a total of 31 borehole water kiosks. Figure 3.1 provides spatial representation of Kisumu County and the locations of the selected boreholes while Table 1 provide a brief description of each of the selected borehole.

Table 1: Selected Community-Managed Boreholes for Study

Sub County	Borehole	Remarks
Nyakach	Bolo Water project (*7 water kiosks, serving over 95 households within 3 villages*)	The project was implemented by CRS in 2008 and metered at implementation. Population density of the area is low. There exists other water sources.
	Oremo Water Project (*3 water kiosks, serving over 110 households within 3 villages*)	The project was constructed by World Vision in 2017 and metered at implementation. Population density of the area is low. There exists other water sources.
	Ragen Water Project (*6 water kiosks, serving over 75 households within 3 villages*)	The project was constructed by World Vision in 2017 and metered at implementation. Population density of the area is low. There exists other water sources.
Nyando	Boya Water Project (*5 water kiosks, serving over 445 households within 5 villages and one vocational polytechnic*)	The water project was constructed in 2002 by SANA. Only 2 CWPs were metered by then. The rest of the CWPs were constructed in 2005 and metered. Water vendors are dominant. It is estimated that handcarts carrying 12no 20lits jerricans work at least 2 trips per day
	Olasi Water Project (*5 water kiosks, serving over 260 households within 6 villages and one health centre*)	The borehole and the entire implementation was conducted by CGK on the FY 2016-17. Population density of the area is low. There exists other water sources.
	Withur Water project (*4 water kiosks, serving over 190 households within 2 villages*)	The borehole was drilled by WSTF in 2013. Kiosks were constructed in 2016 and metered at implementation. Population density of the area is low. There exists other water sources
Seme	Alwala Water Project (*1 water kiosks and school point, serving over 60 households within one village and one school*)	The project was constructed in the year 2015 to serve the school; and the kiosk was constructed in 2016 and metered to serve community. Perceived unsafe water points exist nearby. Project lack funds for expansion.
	Korwenje Market Water Project (*3 water kiosks, but only one serving over 100 households within 3 villages*)	The borehole was drilled in 2018. Expansion and kiosks constructed in 2020. Perceived unsafe water points exist nearby and some people prefer them due to distance to the kiosks.
	Kuoyo-Kaila Water Project (*3 water kiosks, serving over 160 households within 3 villages*)	The borehole was drilled in 2005. Expansion and kiosks constructed in 2018. Perceived unsafe water points exist nearby and some people prefer them due to distance to the kiosks.

Sampling, Tools, Data Sources and Collection

The three focus group discussions (FGD) was conducted with 37 operators, attendants or salespersons as participants for the respective water kiosks of the 9 boreholes as participants from all the 3 sub-counties. The FGD in Nyakach had 13 participants (6 females and 7 males); Nyando had 16 participants (7 females and 9 males); and Seme had 8 participants (4 females and 4 males). The FGD guide was used as a tool to solicit for discussions on the topical issues, with the responses being audio-recorded. The recording was transcribed by a specialist and the translation for local Dholuo language translated an English language expert from a local public

university. The transcribed and translated data was the analysed using the NVivo software into primary and secondary stages.

Three key informant interviews (KIIs) were conducted. The first KII was conducted with one County Water officer in charge of coordinating the NGOs working water, sanitation and hygiene sector within Kisumu County. The second KII was conducted with treasurer of one of the selected boreholes in Nyando Sub-County. The last KII was conducted with the secretary for one of the selected boreholes in Seme Sub-County. The audio-recordings of the KIIs were transcribed as the raw data and were analysed using the NVivo software programme.

The households' surveys were conducted in 460 households distributed within the 9 selected boreholes from the 3 Sub Counties. The households were proportionately distributed within the Sub Counties. Furthermore, these 9 boreholes had 31 community-managed water kiosks with a proportionate representation for the surveyed households. The generated data was organized, cleaned and coded before being analysed with the SPSS software. Descriptive statistics and cross tabulations were generated with the Chi-squares showing relationship between the selected variables.

Study Findings and Discussions

Socio-Demographics

The mean ages for the household heads was found to be 48.06±14.4 years. The household density was found to be 5.41±3.0 people. The responding households had 41.3% of household headed by females while 58.7% of were male-headed. The households' head main occupation was farming (37.9%) followed by business while employment and self-employment represented by 10.2% and 10.9% respectively. Least proportion of household (3.1%) were either household wife or husband.

The mean duration of operations for the borehole water kiosks was found to be 9.13 ±4.696 hours during the day with the modal duration being 12 hours. The modal duration for a round trip (time to the water point, queuing and back to the house) was found to be 15 minutes. The average number of times the households collected water from the boreholes as a water sources was found to be two trips in a day.

Household Seasonal-Switching of Water Uses

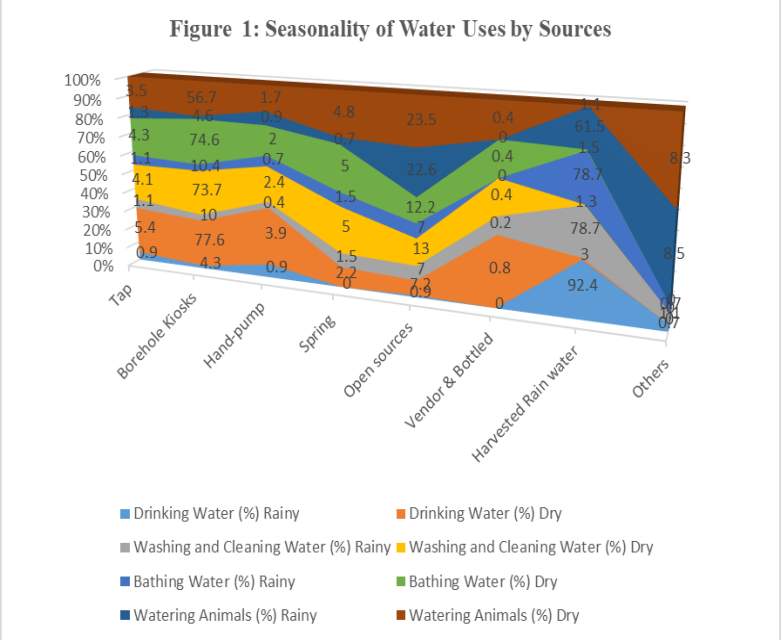
The study sought to understand the seasonality (in dry or rainy seasons) of use of water by households for various activities. The major uses considered for the study included safe water for household drinking, bathing, watering animals, irrigation, cleaning and washing. Table 3 shows the seasonal fluctuations in water uses by the different proportions of households during the different seasons.

For instance, during the rainy seasons, majority of households (92.4%) of the households used the harvested rain water as their main source of drinking water. Meanwhile, over 60% of households reported to be using the harvested rain water for washing and cleaning, bathing and watering their animals during rainy seasons.

Table 3: Seasonal Fluctuations on Water Sources by Use

	Drinking Water (%)		Washing and Cleaning Water (%)		Bathing Water (%)		Watering Animals (%)	
	Rainy	**Dry**	**Rainy**	**Dry**	**Rainy**	**Dry**	**Rainy**	**Dry**
Tap (compound or plot)	0.9	5.4	1.1	4.1	1.1	4.3	1.3	3.5
Borehole Kiosks	4.3	77.6	10.0	73.7	10.4	74.6	4.6	56.7
Hand-pump	0.9	3.9	0.4	2.4	0.7	2.0	0.9	1.7
Spring	0.0	2.2	1.5	5.0	1.5	5.0	0.7	4.8
Open sources	0.9	7.2	7.0	13.0	7.0	12.2	22.6	23.5
Vendor & Bottled	0.0	0.8	0.2	0.4	0.0	0.4	0.0	0.4
Harvested Rain water	92.4	3.0	78.7	1.3	78.7	1.5	61.5	1.1
Others	0.7	0.0	1.1	0.0	0.7	0.0	8.5	8.3
Total Proportion	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

On the other hand, during the dry seasons, the main sources were reversed. Highest proportion (77.6%) of the households reported to be using water from the community-managed (public) borehole kiosks. This trend was shown to be the same for other uses including the households fetching for washing and cleaning (73.7%), bathing (74.6%) and watering animals (56.7%) from water kiosk as their main water for the listed uses during the dry periods. Figure 1 is the graphical representation of the seasonal use of water from the various sources.



With regards to reasons for using the borehole water kiosks, there were observable justifications why the households used them during the dry seasons. For instance, across the various uses (drinking, washing and cleaning, bathing and watering animals), over 45% of the households reported that the water kiosks were the only sources available. On the other hand, 39% acknowledged that the borehole water kiosks were the only water sources close to their homesteads during the dry seasons.

The frequency on the number of trips the households made to the water kiosks was fairly distributed among the different uses across the two seasons. It was found that over 45% of households would make up to two trips to fetch water for drinking, washing and cleaning, bathing and watering animals from the community-managed borehole water kiosks during rainy season. On the other hand, the proportion of households fetching water for drinking, washing and cleaning, bathing and watering animals from the community-managed borehole water kiosks would increase to over 65% during dry seasons.

There was a household category identified as not applicable. This would be described as those who have water within their compound, either as a tap connected to the boreholes or harvested rain water. The proportion of this category were noted to be high, with the lowest being 33.5% for bathing, during rainy seasons. However, during the dry season, the proportion of this category was so reduced, with the highest being slightly more than 6.3% for washing and cleaning, during the dry seasons.

The other variable analyzed was on the durations for round trip for fetching water for drinking, washing and cleaning, and bathing from the community-managed borehole water kiosks. During rainy seasons, over 80% of the households reported to have spent no time or less than 5 minutes to fetch their water for drinking, bathing, washing and cleaning from the community-managed borehole water kiosks. However, during the dry seasons, slightly over 50% of the households reported to have spent between 6-30 minutes to fetch their water for drinking, bathing, washing and cleaning from the community-managed borehole water kiosks. Table 4 provides information on these durations for the round trips.

Table 4: Seasonal Durations for Water Collection Round Trip

Categories of Timing	Drinking Water (%)		Washing and Cleaning Water (%)		Bathing Water (%)	
	Rainy	Dry	Rainy	Dry	Rainy	Dry
No time taken, within dwelling	64.1	12.4	61.1	12.4	59.8	12.6
1-5 minutes	22.2	14.1	25.1	13.5	21.7	12.0
6-15 minutes	11.1	25.2	7.8	26.1	10.0	23.5
16-30 minutes	1.1	25.9	2.8	25.7	5.9	25.0
31-45 minutes	0.7	10.0	7.0	12.2	1.7	11.1
46-60 minutes	0.2	5.4	0.9	5.4	1.3	6.5
More than 60 minutes	0.0	4.1	0.9	2.6	0.7	4.1
Do not know	0.7	2.8	0.7	2.2	0.9	5.2
Total Proportion	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Coincidentally, the proportion of households taking less than 5 minutes reduced considerably from one rainy seasons to the dry seasons. This finding was observed across all the observed water uses. However, from the proportions of households that spent 6 minutes or more, the proportion increased from one rainy season to the to the dry season. In a similar pattern, this finding was observed across all the observed water uses.

In one of the focus group discussion sessions, the participants reported "…At times, the kiosks are forced to ration water, turn off during certain times, sometimes the supply does not start early in the morning but rather at midday to effect this rationing…". Such rationings were

majorly reported to be undertaken during the dry seasons, when there might be fluctuations in the borehole water resting level.

As we conclude this section, the following observations can be made. First, many households switched majorly from the harvested rain water source during rainy seasons to the borehole water kiosks during the dry seasons. Second, the seasonal switching by households was because the community-managed borehole kiosks were either the only source of water available or the source closest to the households switching their sources. Third, the duration for a return trip to the borehole water kiosks to fetch water for many of the households was up to 30 minutes during dry seasons. Finally, the number of daily trip for the households to collect water remained fairly constant even in the different (rainy or dry) seasons.

Water Kiosk Sustenance of Household Rural Livelihood during Dry Seasons

The study sought to examine the influence of the community-managed borehole kiosks on sustaining the rural livelihoods during the dry seasons. The critical rural household livelihoods during dry seasons were taken to include safe water for household drinking, irrigation of the kitchen gardens, and watering their domestic animals. Table 5 provides a comparison of the proportion of the respondents from the study sites on the different use of water from different sources.

Table 5: Household Proportion of Water Use During Dry Seasons

Water Source	Drinking (%)	Watering Animals (%)	Irrigation(%)
Taps (within plots or compounds)	5.4	3.5	3.7
Borehole water kiosks	77.6	56.7	45.2
Hand pumps	3.9	1.7	6.7
Spring	2.2	4.8	11.3
Open sources	7.3	23.5	0.0
Vendor or Bottled water	0.2	0.4	1.1
Harvested rain water	3.0	1.1	32.0

Majority of the rural community households (77.6%) fetched their drinking water from the community-managed borehole water kiosks. However, a negligible proportion of 7.3% and 5.4% fetched their drinking water from the open sources and taps within the compounds respectively. This finding shows that a huge majority of rural households within the study area depended on the borehole water kiosks, to a great extent, for their supply of safe water for drinking. While the open sources (dams, rivers, pans, or lakes) were found to be the second alternative, water from such sources are not considered safe for drinking, and require treatment before the water is made safe for human consumption. In rural areas, dry seasons were also compounded with insufficient and increased costs for food purchases. Thus, treatment for water from open sources might imply a reduction in or competition for the purchasing power available for the rural households.

More than half of the households (56.7%) responded that they used water from the community-managed borehole water kiosks for watering their animals during dry seasons. Less than half of that proportion (23.5%) reported to be using water from open sources for watering their animals. In the rural areas, it was assumed that most of the domestic animals were indigenous and such animals do not need safe water, thus the high proportion of household use

of water from the open source was acceptable. However, for more than half of all the households to prefer to use the water from the community-managed borehole water kiosks had possible two implications. First, dry season results in drying up of some of the open sources, including pans and rivers. Thus, the households living close to such dried open sources have no other alternatives, except the borehole kiosks. Second, as was earlier shown, 45.9% of the households reported that the borehole water kiosk was the only sources available to them while 43.5% of the households reported that the borehole water kiosks were the only source close to them. As well, most of the households might have already depleted the harvested rain water while other sources might have dried up; and therefore, could not be available for use.

On the irrigation of the kitchen garden as a livelihood, 45.2% of the households reported to be using water from the borehole water kiosks while 32.0% were using water from other sources not initially listed for their kitchen garden irrigation. At the same time, 11.3% of households reported to be using water from the spring for their kitchen garden irrigation. The proportion (32.0%) reporting the use other water sources could be referring to use of waste or recycled water from cleaning and other after-use remains. Furthermore, having nearly about 50% of the households using the underground water (45.2% for borehole kiosks and 6.7% from hand pumps) was such a significant contribution from these sources.

In reflection with one of the key informants, she observed that "… there are instances when water flows the whole day from 6 am to 6 pm, while other times it only flows for a few minutes…". This was in response to fluctuation on the dependence of the community-managed borehole water kiosks by the households during the dry seasons. The results showed that, sometimes the only available water source for the community livelihood activities were the borehole water kiosks.

As we conclude, the results show the important contribution of community-managed borehole water kiosks on sustaining the households' livelihood in the dry seasons. As well, the results show the important influence of the community-managed borehole water kiosks on sustaining the rural livelihood in the dry seasons. The results further showed that more than half of the rural households collected and fetched their safe water for drinking, irrigation of the kitchen gardens and watering their animals from the community-managed borehole water kiosks during dry seasons.

Influence and Interaction of on Water Kiosk Beneficiary Characteristics and Household Resilience during Dry Seasons

This aspect of the study observed the relationship for the three livelihood uses of water including household drinking, watering animals, and irrigation of kitchen gardens. The observed variables included the household choice of, reason for choosing, frequency of collecting and time taken to fetching from that water source. The household characteristics framework within which these observations were made remained the gender household headship. Table 6 provides the relationship and interaction with selected of the beneficiary characteristics and household resilience during the dry seasons.

Table 6: Beneficiary Characteristics Interaction with Household Resilience

Observed Variables	Interaction and Relationships with Water Use (χ2))		
	Drinking	Animals	Irrigation
Household choice of water source during dry season	0.039	0.113	0.251
Household reason for choice of use of water from the selected water source	0.546	0.603	-
Household frequency of collecting water from the selected water source	0.008	0.141	0.205
Time taken by households for a round trip to collect water from the selected source	0.016	0.001	-

For the drinking water, the findings showed that the relationship with the gender household head had statistically significant relationship with the household choice of the water source during dry season (χ2=0.039); the household frequency of fetching water from the selected source (χ2=0.008); and time taken by the households for round trip to fetch water from the selected water source (χ2=0.016). However, the relationship between the household reason for the choice of use of water from the selected water source and household gender headship was not statistically significant (χ2=0.546).

The other livelihood uses (watering animals and irrigating kitchen garden) of water from the water kiosks had no statistically significant relationship with the household gender headship. The exception to this was the time taken by the households for a round trip to fetch water for watering animals, which had a statistically significant relationship with the gender headship of the household (χ2=0.001).

The second level of observations included household satisfaction with the drinking water; household perception on availability of water when needed; seasonality of fetching trips; frequency of use of the drinking water from the water kiosk. The other variables observed included the person from the household fetching the water; the containers used for drinking water fetching, transportation and storage by the households; and sufficiency of the water fetched for the household livelihood.

Table 7: Household Satisfaction with Beneficiary Characteristics

Observed Variables	Relationship (χ2)
Household satisfaction with drinking water from the water kiosk	0.277
Household perception on availability of water when needed	0.168
Season when several trips are made to collect water	0.658
Frequency of use of the water source	0.123
Persons collecting water for the household	0.023
Containers used to fetch water	0.021
Containers used to transport water to the household	0.298
Containers used drinking water storage at the household	0.310
Sufficiency of water collected	0.654

The findings show that the persons fetching water for the household (χ2=0.023); and the containers used for fetching water from the water kiosks (χ2=0.021) had statistically significant relationships with the gender of the household heads. As shown in Table 7, the relationship with the other variables in this category was statistically not significant.

From the framework of geographical locations of the water sources, the households in Nyando Sub-County were most satisfied (58.3%) while households in Nyakach Sub-County were extremely dissatisfied (36.6%) with borehole water kiosks as drinking water source. The relationship between water sources (for drinking, watering animals and irrigation of kitchen gardens) with the geographical location were was found to be statistically significant ($\chi 2$=0.009). The relationship between frequency and duration of using water kiosks (for drinking, watering animals and irrigation of kitchen gardens) with the geographical location were statistically significant. Except for drinking water, the relationships between the reason for using a water kiosk source (cleaning, bathing and watering animals) and geographical location were statistically significant.

From the framework of gender household headship, the female-headed households were most satisfied (58.3%) while the male-headed households were extremely dissatisfied (57.8%) with borehole water kiosks as the drinking source of water. However, the relationships between the gender of the household head and the borehole water kiosks as the drinking water source was found to be statistically insignificant. Furthermore, except for drinking water, relationship between water sources (for watering animals and irrigation of kitchen garden) and the gender of household head were found to be statistically insignificant. Relationship between drinking water sources and the gender of household head with source was significant ($\chi 2$=0.035). The relationships between the reason for the household using water kiosk source (for drinking, and watering animals) and gender of household head were found to be statistically insignificant. In another observation, the relationships between frequency of the households using a water kiosk source (drinking, watering animals) and gender of the household head were found to be statistically significant. Exception was with watering animals. Finally, the relationship between duration of members of household round trip for using borehole water kiosks (for drinking, watering animals and irrigation) with the gender of household head were found to be statistically significant.

From the framework of the household socio-economic status, the least poor households were most satisfied (33.3%) while the poorer households were extremely dissatisfied (22.2%) with borehole water kiosks as the sources of drinking water, with a statistically significant relationship ($\chi 2$=0.003). The relationship between water kiosk as the source for watering animals and the household socio-economic status was found to be statistically significant ($\chi 2$=0.026). On the other hand, the relationship between water sources (for drinking and irrigation of kitchen gardens) with the household socio-economic status was found to be statistically insignificant.
The relationships between the frequency of households collecting water (for drinking, and watering animals) with the household socio-economic status was found to be statistically insignificant.

In conclusion, several beneficiary characteristics that were observed, a few were shown to have statistically significant relationships with the household gender headship. These included the household choice of the water source, frequency of collecting water, time duration for a round trip for water collection, person collecting water, and the containers used for collecting the water. In one focus group discussions session, the participants reported that "… with time demand outstrips the supply and this creates tensions when some people especially private consumers fail to get their regular supply…".

Study Conclusions and Recommendations

The findings from other previous researchers and authors showed that the climatic change was real with observable changes reported by the households. Some of the recorded climate changes observed and reported by such authors included the rising temperatures; declining rains; increased drought frequency; and seasonal changes in water sources. This study showed that the borehole water kiosks remained a formidable long-term source of safe water for rural households.

Therefore, there is need for further study to investigate impact of the climatic change on livelihood of female headed households. Finally, there is need for improving the water kiosk service conditions for Nyakach Sub-County.

Ethical Issues

The study got approval from NACOSTI and ethical review by the Daystar University Ethical Review Board as well as Swiss Federal Institute of Aquatic Science and Technology (EAWAG). Further consents were received from the Department of Water, Kisumu County Government, respondents and participants.

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