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Community Based Water Resource Conservation in the Southern Rangelands of Kenya

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Abstract

Water insecurity is a threat to pastoral livelihoods and sustainability. The Water Act of 2002 created the Water Resource Users' Associations (WRUAs) to enhance water resource conservation and enhance water access at the local level. Yet, environmental degradation has increased in recent times, further exacerbating water crisis and threatening livelihoods. This study sought to assess the status of community based water resource conservation in the Southern rangelands of Kajiado, Kenya. Kiserian WRUA members were purposively sampled for this survey. Focus group discussions and key informant interviews were also conducted to validate the data. Chi-square and descriptive statistics were used to analyze the data using SPSS version 20.

Results indicated that access to information on water resource management was significantly associated ($\chi 2=0.56$, $p\leq 0.05$) with membership to the WRUA. Majority (79.5%) of the Kiserian WRUA members had participated in tree planting within the catchment. Half (50%) of the WRUA members were mainly motivated to join the association because of perceived benefits like improved access to water at lower prices and participation in catchment protection. The main challenge facing the WRUA was lack of funds (93.2%). This study recommends awareness to increase WRUA membership and allocation of sufficient funding from the government and other related stakeholders to WRUA conservation activities, if catchment conservation for improved water access in the area is to be realized.

Keywords: Kiserian; Community Based Water Resource Conservation; Water Resource Users Association

Abbreviations: WRUA: Water Resource Users Associations; WRMA: Water Resource Management Authority; WSP: Water Service Providers

Introduction

Water insecurity has been linked to poverty and disease in most parts of the world, as impeded access and affordability of water hampers human well-being and development [1-3]. In order to address the water crisis, there have been concerted efforts by several stakeholders especially in rangelands of Africa, where both statutory and customary set-ups play major roles in water management [4]. These efforts have been triggered by the realization that natural resource dependent economies such as pastoralism are vulnerable to climate change and variability, and as such, possess low adaptive capacity [5-7].

Kenya instituted key reforms in her water sector, culminating in the enactment of the Water Act (2002), and subsequent establishment of various Water Resource Users Associations (WRUAs) by the Water Resource Management Authority [8,9]. Some of the responsibilities on water management were decentralized to lower government institutions; non-governmental organizations were mandated to provide water and manage water resources, provision of water resources was alienated from Water Resource Management Authority and policy making disintegrated from daily operations of institutions dealing in water [10,11]. The Act vested the power to manage water resources on the Water Resource Management Authority (WRMA), with the Ministry of Water and Irrigation playing the policy and oversight role. The WRUAs were formed and exempt from supplying water, yet mandated to conserve water resources at the local level [12].

Community based water resource management through the WRUAs has gained popularity in most parts of Kenya [10,12]. WRUAs have been identified as key instruments in improving water access and availability especially in the rangelands where land degradation and low rainfall have limited the capacity of ecosystems to provide adequate water resources [13,14]. This can be achieved by formulation of conservation strategies unique to particular regions' climatic conditions and livelihood options. Currently, there is a spill of population from urban centers into the rangelands of Kenya and as such, water demand in these areas has been further stretched beyond the supply [15].

Insights on community water resource conservation and management are vital if the government and other stakeholders are to realize improved water access and reduced land degradation in the rangelands. Previous studies have shown that the rangelands of Kenya experience acute water shortages that adversely impact on livelihoods of the people [16-20]. However, there is insufficient information on community based water resource conservation in these areas. Water interventions have therefore been haphazard and without empirical scientific evidence on how local communities can improve availability of water from natural sources such as rivers and springs. This study therefore sought to establish the status of community based water resource management in the southern rangelands of Kenya to inform future interventions.

Materials and methods

Study area

The study was done in Kiserian, Kajiado County (Longitudes 360 5" and 370 5" East and Latitudes 100" and 30 0"). The altitude ranges from 1580 to 2460 metres above sea level. Kiserian is found in agro-ecological zone IV and is therefore a semi-arid region. Rainfall is bimodal in its distribution. The first rains, locally referred to as long rains are received from March to May while the short rains (second rains) fall between October and December [18]. The seasonal rainfall received within the County is between 300-1250mm [21]. The minimum and maximum mean diurnal temperatures are 100c and 240c respectively [22]. The r/ET0 is < 0.65 [23]. The main soil type in Kiserian is vertisols which are sticky when wet and form large cracks when dry [24,25]. Acacia mellifera, Acaciatortilis, Acacia nubica, Acacia ancistroclada, Acacia nilotica, Commiphora riparia,Commiphora africana and Balanites aegyptiaca are the most common species [26].

Figure 1 the area has a population of about 202, 651 people with a population growth rate of 4.5% and a life expectancy of 45 years [27]. The main land use and livelihood source is livestock rearing, although livelihoods have been diversified in order to capitalize on emerging social and economic opportunities and minimize environmental risks [18]. Formal employment, trade, cultivation and group ranching are replacing subsistence pastoralism in the area, especially among the traditionally nomadic Maasai community [16].

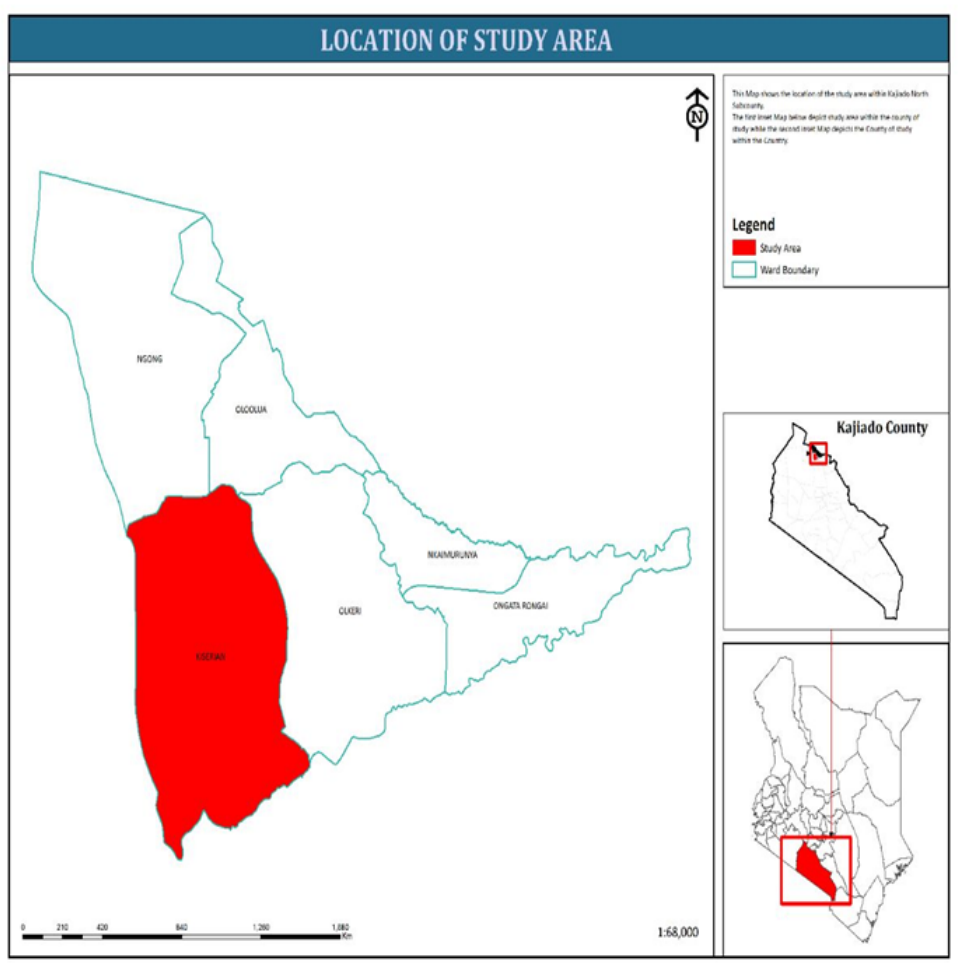

Figure 1: Map of Kajiado County, Kenya showing Kiserian (in red).

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Research design

A survey was used for this study. Descriptions were given for the various subjects including motivation, benefits and challenges of WRUA membership discussed under this research.

Population Sampling

Primary data obtained by interviewing Kiserian water users was used for this study. Purposive sampling was used to select Kiserian WRUA members for interviews. According to Mugenda & Mugenda (2003), 10-50% of the population can be taken as a representative sample. Out of the 60 members of the Kiserian WRUA, 44 were selected using the formula;

$n=(z^2\ pqN)/(e^2\ (N-1)+z^2\ pq)$.....(1)

Where n=sample size,

N=entire population,

z=level of significance (0.05),

e=expected error (0.03),

p=probability that an individual has desirable characteristics and

q=probability that an individual does not have the desired characteristics.

Random sampling was used to select 38 non-WRUA members for interviews using the recommendations of Freund &Williams [28];

$n=(z^2\ pq)/d^2$ .....(2)

Where n=sample size, z=level of significance (0.05), d^2=expected error (0.03), p=probability that an individual has desirable characteristics and q=probability that an individual does not have the desired characteristics.

Questionnaire Administration

A pre-test was done on 10 participating water users to validate the questionnaire before presentation to the selected interviewees. The questionnaire collected information on socio-economic and demographic characteristics of the water users, water sources, motivation and benefits of WRUA membership, capacity building on water resource conservation, WRUA conservation projects and challenges facing the WRUA. Respondents were interviewed to fill the questionnaire under the guidance of trained enumerators for enhanced quality.

Focus group discussion and Key informant interviews

Five focus group discussions were also conducted to verify and reinforce the information obtained from the questionnaire and to gather information on proposals to guide policy review. Two Oloolaiser company officials, one WRMA extension officer, a local chief and the chairperson of the Kiserian WRUA were used as key Informants for the study.

Data analysis

Data analysis was done using SPSS version 20. Qualitative data was presented as tables and discussed. Quantitative data was organized and descriptions given in frequencies, means and percentages. Chi-square tests were done to determine the association between categorical variables. Significance was obtained at $p \leq 0.05$.

Results and Discussion

Social and demographic characteristics of Kiserian water users

A majority of WRUA members (70.4%) and non-members (65.8%) interviewed were male, whereas 29.6% and 34.2% of WRUA members and non-members interviewed, respectively, were females. The mean age of the respondents was 41.85 years. These findings could be attributed to the fact that men are the main decision makers in most households in the Kenyan rangelands [5] and could therefore decide on their membership status without any consultation with other household members. The findings concur with Lugusa [29] who observed that pastoral community based organizations in the Baringo, Kenya were male dominated based on the fact that most households were male-headed. Agevi et al. [30] also found out that men in Malava, Kenya were more likely to join community groups than women because of the benefits they expect. As reported by Coulibaly-Lingani et al. [31], household chores and reproductive roles deterred women from joining community conservation groups.

Most of the respondents (37.8%) had attained primary education while 20.1% had no formal education at all. Secondary and tertiary education had been attained by 24.4% and 18.3% of the respondents, respectively, a status greater than the county's documented education levels where only 7.8% of the population had attained secondary education [32]. Pastoralism was found to be the main land use and was the predominant source of livelihood (30.4%). Cultivation of crops was the main livelihood source for 19.5% of the respondents while 23.2%, 10.9% and 15.8% of the respondents earned their livelihood mainly from business, formal employment and casual labour, respectively. Kajiado County Integrated Development Plan 2013-2017 [32] stated that a majority of the population within the County are livestock keepers, which concurs with our findings. Homewood [33], Okello et al. [19] and Omondi et al. [34] also reported that livestock rearing was the main means to livelihood in Kajiado County, Kenya. Species reared included cattle, sheep, goats and donkeys although most respondents revealed from the focus group discussions that cattle had declined within their herds, concurring with the findings of Western & Nightingale [35] and Lugusa [29] that preference for shoats had increased among Kenyan pastoralists.

Businesses, formal employment, crop cultivation and casual labour emerged as alternative livelihood sources. The

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diversification in livelihoods could have been triggered by changing climate, a shift in lifestyle and food preferences and a need to gain from emergent socio-economic opportunities. These results are consistent with those of Okello et al. [36] that outbreak of zoonotic diseases, shrinking land and diminishing livestock numbers had led to livelihood diversification in Kajiado County. The observations of this study further corroborate with those of Lamprey & Reid [37], and Homewood [33] that lifestyle and food preference change were key drivers of livelihood diversification among the Maasai community of Kenya.

Categories of water users in Kiserian

Table 1: Categories of water users in Kiserian.

Variable	Frequency (N=70)	Per Cent (%)
Crop cultivation	8	9.8
Livestock keeping	23	42.7
Domestic users	33	40.1
Business	3	3.7
Forestry	3	3.7

Table 1 shows water use in Kiserian, Kajiado County. Water was mainly used for livestock rearing (42.7%) and domestic purposes (40.1%). Other main water uses included crop cultivation (9.8%), business (3.7%) and forestry (3.7%). Increased urbanization of Kiserian could justify the high proportion of domestic water users where populations working in Nairobi and its environs living in the study area have increased in the area in recent years [38]. Reed et al. [39] reported that livestock keeping was the main water use in the rangelands of Kenya. Opiyo et al. [17] and Omondi et al. [34] also showed that livestock production was the predominant water use in Mwingi and Amboseli, Kenya, respectively.

Type of water sources in Kajiado

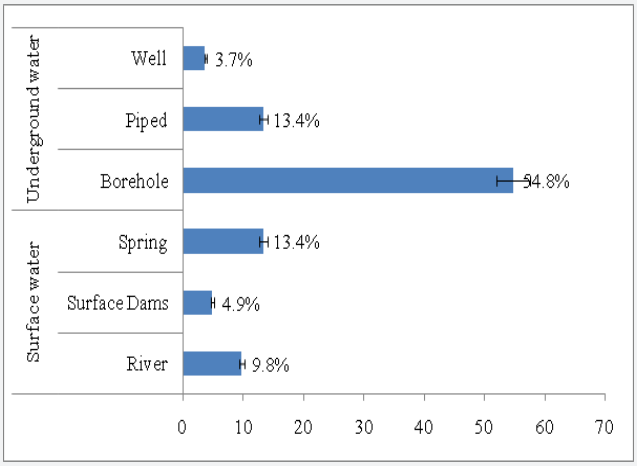

Figure 2: Types of water sources in Kiserian.

Surface and underground water sources were used by residents in the study area (Figure 2). The most prevalent water resources used was borehole (54.8%). Other water sources included piped water (13.4%), wells (3.7%), rivers (9.8%), surface dams (4.9%) and springs (13.4%). The widespread use of borehole water in Kajiado County emanates from the fact that the County suffers from water scarcity which necessitated water intervention measures [16,19]. These measures include drilling of boreholes and supply of tank water by the Ministry of water and the County government, respectively [32]. A dam was also built in 2011 to boost water supply in the region [38]. Wahome et al. [40] and Kiringe et al. [20] also observed that boreholes were the major source of water in Kajiado and Samburu respectively. Underground water was also reported to be more accessed compared to surface water in Yemen [41] due to prolonged use and reliable supply during droughts.

Motivation and Benefits of Joining WRUA Membership

Table 2a: Motivation and benefits of WRUA membership.

	Variable	Frequency (N)	Per cent (%)
Motivation for joining WRUA	Water shortage experience	19	43.2
	Catchment protection	30	68.2
	Pressure from neighbours	4	9.1
	To access training	17	38.6
	Passion for community service	11	25
Benefits of WRUA membership	Improved water access	18	40.9
	Access to water management information	17	38.6
	Enhanced community awareness	12	27.2
	Participation in catchment protection	22	50
	Access to market for trees	1	2.3
	New farming methods	7	15.9

The motivating factors and benefits of WRUA membership are presented in (Table 2a). A majority (68.2%) of the members were motivated by desire to protect the catchment while water shortage experience and desire to access training were motivating factors for 43.2% and 38.6% of the members, respectively. Peer pressure and passion for community service motivated 9.1% and 25% of the members to join the WRUA, respectively. Experience of drought and perceived benefits have been observed to be the main factor motivating rangeland community members to join climate change adaptation and conservation groups [5,29]. Acute water shortages especially during droughts might have created awareness among members on the need to conserve the catchment and consequently influenced them to join the WRUA. Similar observations were reported by Kyeyamwa et al. [42] where farmers formed groups to boost their chances of accessing credit and fertilizers. While conducting a study on factors

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motivating household participation in fodder groups in Baringo, Lugusa (2015) observed that drought experience was the main motivating factor in joining the fodder groups. Half (50%) of the members had benefited by participation in catchment protection while 40.9% of the members had benefited through access to water resources.

Table2b: Capacity building on water resource conservation.

	WRUA Members		Non-WRUA Members		Chi square value	p-value
	Frequency	Per Cent	Frequency	Per Cent	($\chi 2$)	
Access to training	35	79.54	5	13.16	0.71	<0.001
Access to information	41	93.18	12	31.58	0.56	<0.001

Table 2c: Daily water demand, supply and cost (per 20L gallon) in Kiserian.

WRUA members			Non-WRUA members	
Variable	**Mean**	**Std. deviation**	**Mean**	**Std. deviation**
Daily household water demand(m^3) 0.17 0.1	0.17	0.1	0.23	0.1
Daily household water supply(m^3)	0.15	0.1	0.2	0.1
Price per 20L gallon of water(Kshs)	11.3	4.6	12.6	5.4

Other benefits of membership included access to water conservation information and training (38.6%), enhanced community awareness (27.2%), access to market for tree seedlings (2.3%) and acquisition of new farming methods (15.9%). Most governments in Africa use community based organizations in up-scaling technologies that enhance rural economies as opposed to targeting individuals [43,44]. Local community groups therefore provide structures for the government and other development agencies to carry out technology transfer and capacity building. Key Informant Interviews revealed that WRMA, Ministry of Livestock, non-governmental organizations, Kenya Tea Development Authority and Water Trust Fund were the main sources of training and information on water resource conservation. Access to information on water conservation and training were significantly associated, with membership to the WRUA ($\chi 2=0.56$, $p \leq 0.05$) and ($\chi 2=0.71$, $p \leq 0.05$), respectively, (Table 2b). As a result, the WRUA members had a higher mean daily household water supply (0.17m3) compared to non-members (0.15m3) and obtained the same amount of water (20L gallon) at a lower mean price of Kshs. 11.25 and Kshs. 12.60, respectively (Table 2c).

Munyua & Stilwell [45] reported that vulnerable communities had formed groups in order to benefit from extension services and capacity building programs offered by the government in Central Kenya. While conducting a study on milk farmers in Meru, Davies et al. [46] observed that rural groups had better access to training as opposed to individual farmers.

Conservation projects carried out by Kiserian WRUA

Table 3 shows the conservation projects undertaken by the Kiserian WRUA members. Majority (79.5%) of the members had participated in river de-silting, 75% in tree planting and 45.4% in river pegging. Lowest participation was observed in riparian area fencing and community sensitization (15.9%). WRUA activities were mainly conservation oriented, and thus in tandem with WRUA mandate outlined by [47]. Tree planting is a widely known conservation measure, and has been used to rehabilitate degraded areas Mogaka (2006). Luwesi, Barder [3] Mathenge et al. [12] witnessed tree planting in rehabilitation of Muooni sub-catchment in Machakos and Ngaciuma sub-catchment in central Kenya, respectively. Low literacy levels have hampered community sensitization programs by community based organizations [48] and could justify the low participation in community sensitization activities by the Kiserian WRUA.

Table 3: Participation in conservation projects carried out by Kiserian WRUA.

Variable	Frequency (N)		Per Cent (%)
Tree planting	33		75.0
De-silting	35		79.5
River pegging	20		45.4
Riparian area Fencing	7		15.9
Community sensitization	7		15.9

Challenges facing the Kiserian WRUA

The challenges faced by the Kiserian WRUA are shown in (Figure 3). The main challenge facing the WRUA (93.2%) was lack of funding. Other challenges included community hostility towards conservation initiatives (29.5%), low literacy among members (40.9%), incompetent leadership (13.6%) and duplication of roles with water service providers (50%). Inadequate funds available to WRUA could be because of the limited funding sources. WRMA was the main financier of the Kiserian WRUA. Community hostility towards conservation initiatives might have been due to inadequate understanding from the general public on the need to

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conserve the catchment. Incompetent leadership could have been caused by the low literacy levels among the members. Most members stated during the focus group discussions that they lacked training in leadership and management.

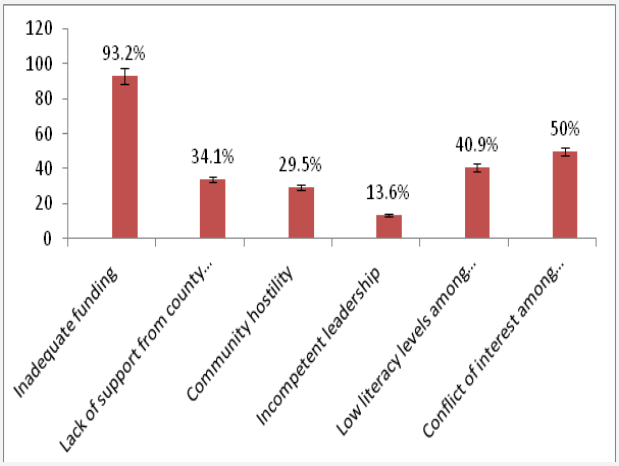

Figure 3: Challenges facing the Kiserian WRUA.

The findings of this study concur with past studies. Agevi et al. [30] observed that inadequate funding was the main challenge facing community based organizations in Malava, Kenya. Murtinho et al. [49] also reported that external financial support significantly enhanced the capacity of local communities to adapt to water scarcity in Columbia. Lelo et al. [50] and Mathenge et al. [12] observed that overlap of roles between Water Service Providers (WSPs) and WRUAs hindered conservation efforts in Nyando basin and Ngaciuma sub-catchment, Kenya, respectively [51-56].

Conclusion and recommendations

The following conclusions can be made from this study;

- Use of boreholes had gained popularity as a water intervention measure aimed at curbing water scarcity in Kajiado County.
- WRUA members had better access to capacity building and therefore accessed water at lower costs.
- The communities in the study area had diversified their livelihood options to better adapt to changing climate and socio-economic landscape
- Funding and duplication of roles were the main challenges facing the WRUAs in the southern rangelands of Kajiado
- Perceived benefits were the main motivation for rangeland communities to join WRUAs.

From the above conclusions, the following recommendations can be made;

1. Community sensitization on roles and benefits of WRUAs should be done to enable a larger proportion of the general public to join the WRUA.
2. There is need for stakeholders to empower the local communities in adopting sustainable livelihood diversification strategies by supporting WRUA activities through funding and technical guidance.
3. Water legislation should be reviewed to avoid overlapping and conflicting functions of water service providers (WSPs) and WRUAs.

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