Open Access Library Journal
2024, Volume 11, e11206
ISSN Online: 2333-9721
ISSN Print: 2333-9705

The Role of Community Awareness in River/Wetland Conservation: A Case of Upper Yala River Watershed

Wamalwa Stella Namusia Wanjala[1], Oloo Micky Olutende[2], Obam Joab[3], Oluchiri Stanley Omuterema[4], Ogallo Steve[5], Wamalwa Rose[1]

[1]Department of Research, Women in Water and Natural Resource Conservation (WWANC), Kakamega, Kenya
[2]Department of Physical Education, Exercise and Sports Science, Kenyatta University (KU), Nairobi, Kenya
[3]Water Resources Authority (WRA), Lake Victoria North Basin Area, Kakamega, Kenya
[4]Disaster Management and Sustainable Development, Masinde Muliro University of Science and Technology (MMUST), Kakamega, Kenya
[5]Department of Geography, Kibabii University (KIBU), Bungoma, Kenya
Email: micky.oloo.mf@gmail.com

How to cite this paper: Wanjala, W.S.N., Olutende, O.M., Joab, O., Omuterema, O.S., Steve, O. and Rose, W. (2024) The Role of Community Awareness in River/Wetland Conservation: A Case of Upper Yala River Watershed. *Open Access Library Journal*, **11**: e11206.
https://doi.org/10.4236/oalib.1111206

Received: January 12, 2024
Accepted: February 18, 2024
Published: February 21, 2024

Abstract

Introduction: Nandi County, situated in the North Rift region of Kenya, encompasses a vast and ecologically diverse landscape. The county's river/wetland systems play a crucial role in supporting local livelihoods, biodiversity, and ecosystem services. However, rapid socio-economic changes, coupled with environmental pressures, have raised concerns about the sustainability of these water systems and the communities they support. Despite the significance of the river/wetland systems, there is limited understanding of the community's awareness, interaction, and land usage practices in relation to these water bodies. This knowledge gap hinders the formulation of effective conservation and management strategies tailored to the local context. *Objective:* This study aimed to assess the sociodemographic characteristics of the Nandi County residents, their level of community awareness, land usage practices, and interaction with the river/wetland. *Research Design and Methodology:* The study employed a descriptive cross sectional study design. Utilizing a multi-stage sampling technique, the upper Yala catchment was stratified based on ecological and topographical characteristics. From these strata, sub-catchments were randomly selected, followed by systematic random sampling of households within each sub-catchment. A total of 400 households were surveyed. Data collection involved both quantitative and qualitative methods, with the latter encompassing Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Quantitative data were analyzed using SPSS Version 27, while qualitative data underwent thematic analysis using NVIVO-10

software. *Results:* The population exhibited a balanced age distribution with 54.6% aged 44 years and below. Males constituted 55.0% of household heads. A significant 70.9% of household heads were married, and 29.4% had completed secondary education. Farming was the primary occupation for 74.6% of households. In terms of community awareness, notably, 97.0% of respondents correctly identified the river/wetland as natural. Qualitative findings highlighted varying levels of understanding regarding the seasonality of the water resource, with some households demonstrating accurate knowledge, while others held misconceptions (KIIs: Department of Agriculture Nandi, Water Resource Association). On land Usage and Ownership, a majority, 86.3%, owned their land, with 93.0% using it primarily for agriculture. Qualitative insights revealed diverse land tenure arrangements and the significance of farming in the region (KIIs: Department of Agriculture Nandi, Water Resource Association). With regards to interaction with River/Wetland, 64.2% reported their land stretching into the wetland area, with flooding identified as the primary hazard by 62.4% of respondents. Qualitative data emphasized the challenges faced by households in their interaction with the river/wetland, including waterborne diseases and encounters with wildlife (KIIs: Green Belt Movement, Kenya Forest Service). *Conclusion:* The river/wetland systems in Nandi County are integral to the community's socio-economic and cultural fabric. While there is a commendable level of awareness and interaction with these systems, challenges such as flooding and land usage conflicts underscore the need for integrated management approaches. *Recommendation:* Policymakers and stakeholders must prioritize community-based conservation initiatives, taking into account the local socio-demographic dynamics. Collaborative efforts, encompassing local communities, government agencies, and NGOs, can foster sustainable land usage practices and enhance the resilience of the river/wetland systems in Nandi County.

Subject Areas

Environmental Sciences

Keywords

Nandi County, River/Wetland Interaction, Multi-Stage Sampling, Community Awareness, Land Usage, Conservation

1. Introduction

Water ecosystems, particularly rivers and wetlands, are fundamental in maintaining ecological balance, supporting biodiversity, and providing livelihoods to millions globally (Dudgeon *et al*., 2006) [1]. In regions like the North Rift of Kenya, these systems are not merely sources of water but also underpin the socio-economic fabric of communities. However, as Vörösmarty *et al.* (2010) [2] highlight, freshwater systems worldwide are under threat from human activities, climate change, and other environmental factors.

Nandi County, situated in the North Rift region of Kenya, is enriched by its river and wetland systems. Ongugo *et al.* (2014) [3] emphasize the historical significance of these water bodies, which have been central to the county's identity, providing water for domestic use, and agriculture, and supporting a diverse range of flora and fauna. Over the years, the communities in Nandi County have developed a symbiotic relationship with these ecosystems. However, as Githeko *et al.* (2009) [4] point out, rapid urbanization, agricultural expansion, and changing land use patterns are beginning to strain these systems, leading to degradation and loss of biodiversity.

Despite the integral role of river and wetland systems in Nandi County, Jenkins *et al.* (2010) [5] argue that there is a significant gap in comprehensive research on how local communities interact with these resources. The sustainability of these systems is under threat, and without a clear understanding of the socio-economic and cultural dynamics, conservation efforts may not be effective. This sentiment is echoed by Turner *et al.* (2015) [6], who stress the need for context-specific conservation strategies.

Berkes (2009) [7] posits that understanding the intricate relationship between communities and their environment is crucial for effective conservation. This research, therefore, holds paramount importance for several reasons. Firstly, it will inform policy formulation, enabling policymakers to craft strategies that are both effective and context-specific. Secondly, by shedding light on community perceptions and practices, the study will pave the way for community-driven conservation initiatives. Furthermore, insights from this research can guide efforts to protect and restore the biodiversity of Nandi County's River and wetland systems, as emphasized by Sala *et al.* (2000) [8]. Lastly, by promoting sustainable interactions with these ecosystems, the study can contribute to ensuring the long-term livelihoods of the communities that depend on them, a sentiment shared by Adger *et al.* (2005) [9].

The study aims to understand the sociodemographic characteristics of the residents of Nandi County and their influence on interactions with the river and wetland systems. It also seeks to assess the level of community awareness and understanding of these ecosystems, evaluate land usage and ownership practices, and explore the nature and extent of community interactions with the river and wetland. Lastly, the study will identify the primary sources of water for these systems and evaluate their management practices.

2. Methodology

The study employed a descriptive cross-sectional research design. It was conducted in Nandi County. Nandi County is located in the North Rift region of Kenya. It lies between latitude 0°34'N and longitude 34°45'E to the West, while the Eastern boundary reaches Longitude 35°25'E. It covers an area of 2,884.4 Km^2; and borders Kakamega County to the West, Uasin Gishu County to the North East, Kericho County to the South East, Kisumu County to the South, and

Vihiga County to the South West. The baseline survey was conducted in the Chesumei, Emgwen, and Mosop sub-counties.

2.1. Sampling

The project employed a multi-stage sampling technique. In the first stage, the upper Yala catchment was divided into strata based on ecological and topographical characteristics. In the second stage, a random selection of sub-catchments was made from each stratum. In the third stage, households were selected from each sub-catchment using systematic random sampling.

2.2. Sample Size

The sample size was determined using the formula $n = z^2 * p * (1-p) / e^2$, where "n" was the sample size, "z" was the standard normal deviation at the desired level of confidence (95% confidence level), "p" was the estimated proportion of households with conservation investments, and "e" was the desired level of precision (5% margin of error). Based on past studies, it was estimated that the proportion of households with conservation investments was 40%. Thus, the required sample size was 400 households.

The sampling procedure involved the following steps:

- Dividing the upper Yala catchment into strata based on ecological and topographical characteristics.
- Randomly selecting sub-catchments from each stratum.
- Using systematic random sampling to select households from each subcatchment.

The estimated sample size of 400 households was proportionally allocated to *Bomas* and then villages according to the targeted number of beneficiaries. Table 1 shows the detailed sample size distributions by *Bomas*. The sampled number of households per district was proportional to the size of the beneficiary population.

In a multi-stage sampling design with a given sample size, there is no prescriptive formula for determining how many clusters to choose and how many beneficiaries to choose within each cluster. There are competing interests in terms of what is most operationally expedient versus what is most statistically efficient. Due to movement restriction, access, and cost, it is optimal to select the smallest number of clusters possible, with a greater sample size per cluster (assuming a given sample size). When a smaller number of clusters are selected, the time and cost of transportation to, from, and in between the clusters are decreased—and potentially the number of data collectors can also be decreased.

It is possible, however, to provide a rule of thumb concerning the number of sampled beneficiaries to allocate to each sampled cluster. A range of 15 - 35 beneficiaries for each selected cluster is appropriate because, in most cases, this represents a logistically feasible number of beneficiaries per cluster to sample without inducing a design effect that is larger than roughly 2. Based on this "15 - 35

Table 1. Sample size distribution by bomas.

Sub-county	Location (Ward)	Sub location	Household	PP	Estimated	# Villages	Sample
Chesumei	Chemundu	Baraton	300	0.075	30	3	20
		Chemundu	200	0.050	20	2	10
	Chepterit	Chepterit	400	0.100	40	4	20
		Segut	150	0.038	15	2	8
	Kamoiywo	Kimn'geru	250	0.063	25	3	8
		Saniak	200	0.050	20	2	20
	Kapsisiywa	Chepkober	300	0.075	30	3	20
		Sironoi	200	0.050	20	2	20
	Kaptel	Kapkuto	250	0.063	25	3	18
		Kaptel	150	0.038	15	2	8
Emgwen	Kiptuiya	Kapchorwa	350	0.088	35	4	20
		Kaptobongen/kapkirwok	150	0.038	15	2	8
		Kiptuiya	200	0.050	20	2	10
	Kosirai	Belekenya	150	0.038	15	2	8
		Chepterit	200	0.050	20	2	10
	Kapkangani	Chepsonoi	250	0.063	25	3	8
		Tindinyo	200	0.050	20	2	10
	Kapsabet	Kamatargui	300	0.075	30	3	10
		Kapsabet	200	0.050	20	2	10
		Kiminda	250	0.063	25	3	8
	Lolminingai/kilibwoni	Kapkagaon	300	0.075	30	3	10
		Lolminingai	200	0.050	20	2	10
Mosop	Itigo	Jeptarit	250	0.063	25	3	8
		Tamboiyo	150	0.038	15	2	8
	Kabisaga	Chepkoiyo	250	0.063	25	3	8
		Jepkoiyo	150	0.038	15	2	8
	Kabiyet	Kabiyet	300	0.075	30	3	10
		Kamasia	200	0.050	20	2	10
	Kebulonik	Cheplelachbei	250	0.063	25	3	8
		Jeplelachbei	200	0.050	20	2	10
		Kebulonik	150	0.038	15	2	8
		Samgalo	300	0.075	30	3	10
		Tachasis	200	0.050	20	2	10
	Kipsamoite	Jepyewet	150	0.038	15	2	8
		Kamweka	300	0.075	30	3	10
		Kebulonik	200	0.050	20	2	10
		Kugeroniot	250	0.063	25	3	8
	Sangalo	Cheplelachbei	300	0.075	30	3	20
		Kebulonik	200	0.050	20	2	10
Total			7,500		750	76	403

Note: PP-Proportional Piling.

beneficiaries per cluster" rule of thumb, this survey used the rule of thumb approach to decide on the actual number of clusters and beneficiaries per cluster to choose.

The household was carefully selected in consultation with village leaders. Since we don't have a list of HHs per village, the team of data collectors directly went to the sampled villages and asked the village leader to take them to the center of the village. At the center of the village, they spun a pen to determine the direction to move. After they determined the direction, they went to the nearest household and that household was the first interviewee. Then the team moved to the next nearest and selected every 3rd household of the nearest household and collected data until the required number of households were interviewed.

On some occasions selected households may not fit the required criteria, participants may be busy or do not want to participate, or participants may not be at home. In this case, the sampled was household replaced by another household immediately next to the sampled household. The replacements were done in consultation with supervisors.

2.3. Data Management

Data management commenced with the development of appropriate tools followed by the training of data collectors on data collection methods and data quality. During data collection, data quality was assessed at the point it was collected to ensure the correctness and completeness of the questionnaires. Data was collected by online questionnaires downloaded in Excel format and exported to SPSS software (statistical packages for social sciences), cleaned, and analyzed to ensure that any questionnaire with discrepancies could be identified and corrected. Qualitative data was transcribed daily to ensure the information was not lost and to help ensure that all required information was collected during the evaluation fieldwork. The lead consultant was also holding discussions every close of business with the data collectors to ensure they captured all the important information.

2.4. Data Analysis

We analyzed quantitative data using the Statistical Package for Social Sciences (SPSS) Version 27 for Windows. Analysis was done by descriptive statistics. Descriptive statistics was in the form of frequencies and proportions since our data was mainly categorical. Ratio/interval data (scale) was put in bins and hence became categorical.

We transcribed all the qualitative data from the KIIs and FGDs. We used NVIVO-10 software to analyze the qualitative data. In context, qualitative data analysis adopted a thematic analysis approach. This entailed the use of a theory-driven approach where the analysis categories had been determined a *priori* based on the study objectives and project indicators derived from the project log frame.

Following this, a data reduction method was carried out. The first stage involved identifying the common themes around which the analysis should be carried out. This entailed listing all the study indicators and sub-indicators where applicable.

Exploratory analysis of collected data was then carried out. Data (Focus Group Discussion (FGD) transcripts and Key Informant Interviews (KII) were structurally coded and then partitioned in line with the study indicators and sub-indicators where a set of string and numeric codes had been used to represent one given study indicator/sub-indicator and so on. Each discrete question and its probes, forming a domain that corresponded to an indicator, was assigned a code and then linked to the subsequent response text. Within each domain, questions were given code names which included a prefix for the domain and a numeric identifier for the question topic.

2.5. Ethical Considerations

The evaluation was conducted on respondents who had provided informed consent. The eligible respondents were given verbal consent to participate. The purpose and objectives of the study were explained to the respondents in adequate detail to enable them to decide on participation. No respondent was coerced, threatened, or intimidated to participate. They were all respected regardless of their decision to participate or not participate.

3. Results

The age distribution of the population is relatively balanced, with a slightly higher representation of individuals aged 44 years and below (54.6%) compared to those aged 45 years and above (45.4%). In terms of gender, males constitute the majority of household heads (55.0%) compared to females (45.0%) (**Table 2**). When considering marital status, a significant majority of household heads are married (70.9%), while single individuals represent 16.7% of the household heads. Separated or divorced individuals make up the smallest percentage (2.2%), with widows and widowers accounting for 10.2%. In terms of education, a large portion of the household heads completed secondary education (29.4%), followed by those who completed primary education (21.6%). There is a smaller percentage of household heads who did not complete primary (17.4%) and secondary education (14.7%). Very few household heads never attended a formal school (5.7%), and a small percentage attained tertiary-level education (11.2%) (**Table 2**).

Turning to occupation, a significant majority of the households (74.6%) indicate farming as their main occupation. Only a quarter (25.4%) are not engaged in farming. Additionally, business is the main occupation for 22.6% of the households, while a large majority (77.4%) does not engage in business. The main source of income for most households is not formal employment, as only 4.5% of the households derive their income from formal employment, while a significant

Table 2. Bio-data and socio-economic characteristics.

Bio-data and socio-economic characteristics		n	%
Age groups	44 years and below	219	54.6%
	45 years and above	182	45.4%
Gender of the household head	Female	181	45.0%
	Male	221	55.0%
Marital status of the household head	Married	285	70.9%
	Separated/divorced	9	2.2%
	Single	67	16.7%
	Widow/widower	41	10.2%
Level of education of the household head	Completed primary education	87	21.6%
	Completed secondary education	118	29.4%
	Did not complete primary education	70	17.4%
	Did not complete secondary education	59	14.7%
	Never been to a formal school	23	5.7%
	Tertiary level	45	11.2%
The household's main occupation is farming	No	102	25.4%
	Yes	300	74.6%
The household's main occupation is business	No	311	77.4%
	Yes	91	22.6%
A household's main source of income is formal employment.	No	384	95.5%
	Yes	18	4.5%
Family size	5 and below	218	54.2%
	6 and above	184	45.8%

majority (95.5%) do not. Finally, in terms of family size, households with five members or less are slightly more prevalent (54.2%) compared to those with six members and above (45.8%) (Table 2).

3.1. Level of Community Awareness and Understanding of the River/Wetland

When asked about the nature of the water resource, almost all households (97.0%) correctly identified it as natural. A tiny fraction of the respondents either believed it to be man-made (2.0%) or admitted they didn't know (1.0%). This suggests a broad understanding of the river/wetland's natural origin, which could potentially influence attitudes towards its conservation. Approximately three-quarters of the households (74.6%) live within 2 kilometers of the wetland, while the remaining quarter (25.4%) lives 3 kilometers or more away (Table 3). This proximity could influence the households' interaction with and reliance on the wetland and its resources. In terms of residency duration in the area, a majority

Table 3. Awareness and understanding of the river/wetland.

Awareness and Understanding of the River/Wetland		n	%
Approximate distance between the wetland and your home	2 km and below	300	74.6%
	3 km and above	102	25.4%
How long have you lived in this area?	Less than 5 years	18	4.5%
	Over 10 years - 15 years	77	19.2%
	Over 15 years	268	66.7%
	Over 5 years - 10 years	39	9.7%
What kind of water resource is this in relation to its formation?	I don't know	4	1.0%
	Man-made	8	2.0%
	Natural	390	97.0%
What kind of source is this in relation to the availability of water?	I don't know	5	1.2%
	Permanent	380	94.5%
	Seasonal	17	4.2%

(66.7%) have lived in the area for over 15 years, indicating a significant level of familiarity with the local environment. The second largest group has lived in the area for between 10 and 15 years (19.2%), followed by those who have resided there for 5 to 10 years (9.7%). A small percentage (4.5%) has lived in the area for less than 5 years. Qualitative data finding: Participants highlighted that some households were able to correctly identify the formation of the local water resource, while others had limited knowledge or misconceptions. (KIIs: NEMA, Kenya Forest Service)

Concerning the water source's availability, a vast majority of households (94.5%) understood it to be a permanent source. This perception may reflect their reliance on the river/wetland for consistent water supply. A small percentage considered it to be seasonal (4.2%), while an even smaller proportion (1.2%) was unsure about its availability. Results from the qualitative data finding showed that participants expressed varied levels of understanding regarding the seasonality of the water resource. Some households demonstrated accurate understanding, while others had misconceptions or lacked awareness. (KIIs: Department of Agriculture Nandi, Water Resource Association)

3.2. Land Usage and Ownership Practices near the River/Wetland

A vast majority (86.3%) of the respondents own the land where they reside or farm, while a smaller proportion (13.7%) do not. Among those who do not own their land, most (83.6%) indicated that the land is owned by a native person from the area. A few identified the owner as a non-native person (9.1%), the community (5.4%), or the national government (1.8%). Despite not owning the land, most of these respondents (67.3%) have some form of authority over its use granted by the owner. In terms of how they acquired the land they own, the

respondents mentioned various means, including inheritance (37.8%), buying (10.8%), leasing (10.8%), and other means (37.8%). This diversity in land acquisition methods reflects the complexity of land tenure arrangements in the area. When asked about the duration of their stay on the land, most respondents (63.4%) have resided there for over 15 years. Others have lived on the land for 10 to 15 years (18.4%), 5 to 10 years (12.4%), and less than 5 years (5.7%) (Table 4). Qualitative data findings showed that the number of households owning the land where they are living or farming varied across the catchment area. Some households owned the land, while others were renting or had insecure tenure. (KIIs: Department of Agriculture Nandi, Water Resource Association)

Table 4. Land usage and ownership near the river/wetland.

Land usage and ownership near the river/wetland		n	%
Do you own the land where you are staying and/or farming?	No	55	13.7%
	Yes	347	86.3%
If no in above, who is/are the owner(s) of the land?	A person who is a native of this area	46	83.6%
	A person who is not a native of this area	5	9.1%
	The Community	3	5.4%
	The national government	1	1.8%
If no in above, do you have authority from the owner over the use of the land?	No	18	32.7%
	Yes	37	67.3%
If yes in above, how did you acquire this land?	Bought	4	10.8%
	Inheritance	14	37.8%
	Leasing	4	10.8%
	Other(s)	14	37.8%
For how long have you lived in this land?	Less than 5 years	23	5.7%
	Over 10 years - 15 years	74	18.4%
	Over 15 years	255	63.4%
	Over 5 years - 10 years	50	12.4%
I use the land for agriculture	No	28	7.0%
	Yes	374	93.0%
I use the land for recreation	No	401	99.8%
	Yes	1	0.2%
I use the land as a source of water	No	377	93.8%
	Yes	25	6.2%
I use the land for worship or sacrifices	No	400	99.5%
	Yes	2	0.5%
I use the land for other purposes	No	382	95.0%
	Yes	20	5.0%

Most households use their land for agriculture (93.0%), emphasizing the prominence of farming as the main occupation in the region. Land use for recreation (0.2%), as a water source (6.2%), for worship or sacrifices (0.5%), and for other purposes (5.0%) was far less common. These findings indicate a strong connection between the local community and the land, primarily through ownership and agricultural use. This information is vital for understanding local land management practices and shaping interventions that align with these realities to ensure the project's success.

Qualitative data findings showed that participants identified various uses of the land by households, including agriculture, residential purposes, and small-scale businesses. The number and types of land uses varied across the catchment area. (FDGs: Farmers' Group, KANAWASCO). The percentage of households having authority over the use of the land differed among participants. Some households had full control and decision-making power, while others

Table 5. Access to and interaction with the river/wetland.

Access to the river/wetland		n	%
Does your land stretch into the area that is under the wetland?	No	143	35.6%
	Yes	258	64.2%
If yes above, do you face the dangers of flooding in your interaction with the river/wetland	No	96	37.6%
	Yes	159	62.4%
If yes above, do you face the dangers of Attacks by wild animals in your interaction with the river/wetland	No	243	95.3%
	Yes	12	4.7%
If yes above, do you face the dangers of Attacks by frequent diseases in your interaction with the river/wetland	No	212	83.1%
	Yes	43	16.9%
If yes, do you face the dangers of Conflicts over my presence in the river/wetland	No	245	96.1%
	Yes	10	3.9%
If yes above, do you face other dangers in your interaction with the river/wetland	No	197	77.3%
	Yes	58	22.7%
If your land doesn't stretch into the area that is under the wetland, do you have access to the river/wetland?	No	26	6.5%
	Yes	115	28.6%
If not above, is the lack of an access road to the wetland the hindrance to getting to and using the river/wetland?	No	17	70.8%
	Yes	7	29.2%
If not, is the lack of an access road to the wetland the hindrance to getting to and using the river/wetland? If not, is restrained by people neighboring the hindrance from getting to and using the river/wetland?	No	16	66.7%
	Yes	8	33.3%
If not, is the wetland being a private property hindrance from getting to and using the river/wetland?	No	20	83.3%
	Yes	4	16.7%
If not, is restrained by the management the hindrance from getting to and using the river/wetland?	No	23	95.8%
	Yes	1	4.2%

faced restrictions or lacked control due to communal land systems or external factors. (KIIs: Green Belt Movement, Kenya Platform for Climate Governance NOREB).

3.3. Interaction with the River/Wetland

The majority of respondents (64.2%) reported that their land stretches into the wetland area. For those whose land doesn't stretch into the wetland area (35.6%), a significant portion (28.6%) still has access to the river/wetland. Out of the respondents who do not have access to the river/wetland (6.5%), the main hindrances include lack of an access road (29.2%), restraint by neighboring people (33.3%), the wetland being private property (16.7%), and restraint by the management (4.2%) (Table 5). Qualitative data findings showed that the number of households that have access to the river/wetland differed among participants. Some households reported easy access, while others faced challenges such as distance, physical barriers, or restrictions imposed by landowners. (FDGs: Community Members, Center for Community Dialogue and Development)

A majority reported the greatest danger they faced was flooding (62.4%). However, encounters with wild animals are relatively rare, with only 4.7% reporting such incidents. About 16.9% of respondents reported facing frequent diseases due to their interaction with the river/wetland, and a small number (3.9%) reported conflicts over their presence in the river/wetland. Additionally, 22.7% of respondents reported facing other unspecified dangers. Qualitative data findings revealed that participants identified various dangers faced by households in their interaction with the river/wetland, including waterborne diseases, accidents, and encounters with dangerous wildlife. The number of households facing such dangers varied across the catchment area. (KIIs: Green Belt Movement, Kenya Forest Service)

3.4. Sources of Water for the River/Wetland and Management Practices

The most common sources of water mentioned were springs, natural springs, and spring water, with 19.4% of respondents mentioning them. Other sources mentioned include rivers, streams, boreholes, dams, forests, and various streams, among others. With regards to specific names of Rivers/Streams/Drainages, among the respondents who indicated the presence of rivers or streams in the catchment area, the most frequently mentioned river was Kimondi (14.4% of respondents), followed by Kingwal (3.2% of respondents). Other rivers and streams mentioned include Chemogonja, Cheptaburbur, Yala, Budalangi, and St. Mary's, among others. Qualitative data findings revealed that the percentage of households able to name the source(s) of the water in the river/wetland varied. Some households demonstrated good knowledge of the water sources, while others had limited awareness or misconceptions. (KIIs: Kenya Wildlife Service, Department of Health - Public Health Officer)

The majority of respondents (92.3%) understand the river/wetland to be perennial, and a large majority (80.3%) confirmed that the river/wetland has an outflow (Table 6). Among these, the seasonality of the outflow/drainage is perceived as perennial by 85.8% of respondents. Regarding the management of the river/wetland, the data reveals that 88% of respondents do not think the person managing the river/wetland is a native of the area. Almost all respondents (99.8%) do not think the entity managing the river/wetland is an organization or institution. However, a majority (60.1%) believe the community manages the river/wetland, whereas only a small fraction believe the county government

Table 6. Understanding and management of water sources.

Understanding and Management of Water Sources		n	%
How is/are the seasonality (ies) of the river/wetland source(s)	I don't know	10	2.5%
	Perennial	371	92.3%
	Seasonal	18	4.5%
Does the river/wetland have an outflow?	No	75	18.7%
	Yes	323	80.3%
How is/are the seasonality(ies) of the outflow/drainage(s)	I don't know	22	5.5%
	Perennial	345	85.8%
	Seasonal	27	6.7%
Is the person who manages the river/wetland a native of this area	No	353	88.0%
	Yes	48	12.0%
Is the entity that manages the river/wetland an organization or institution?	No	400	99.8%
	Yes	1	0.2%
Is the entity that manages the river/wetland the community?	No	160	39.9%
	Yes	241	60.1%
Is the entity that manages the river/wetland the county government?	No	394	98.3%
	Yes	7	1.7%
Is the entity that manages the river/wetland The national government?	No	389	97.0%
	Yes	12	3.0%
I don't know who manages the river/wetland	No	305	76.1%
	Yes	96	23.9%
The river/wetland is managed by other entities/individuals	No	394	98.3%
	Yes	7	1.7%
How would you propose that the wetland be managed?	By a private individual or organization	32	8.0%
	By the Community	249	61.9%
	By the county government	62	15.4%
	The national government	46	11.4%
	I don't know	10	2.5%

(1.7%) or the national government (3.0%) manages it. A significant portion of respondents (23.9%) indicated they do not know who manages the river/wetland. When asked how they propose the wetland be managed, most respondents (61.9%) favor community-based management, followed by management by the county government (15.4%), the national government (11.4%), and a private individual or organization (8.0%). A small percentage of respondents (2.5%) were unsure of how the wetland should be managed. Qualitative data findings showed that the percentage of households aware of the river/wetland's outflow varied. Some households knew the outflow, while others lacked awareness or had limited understanding of the water flow dynamics. (FDGs: Community Members, Water Resource Association)

4. Discussion

4.1. Sociodemographic Characteristics

The sociodemographic characteristics of the population provide a comprehensive understanding of the community's composition. The balanced age distribution, with a slight inclination towards younger individuals, suggests a dynamic community with the potential for both experienced and youthful perspectives. This age distribution is consistent with global trends where younger populations are predominant in many regions (United Nations, 2019) [10]. The predominance of males as household heads aligns with traditional societal structures observed in many parts of the world, where men often assume leadership roles within families (Doss, 2013 [11]; Agarwal, 1997 [12]). The high percentage of married household heads could indicate a community rooted in family structures, which can influence communal decision-making processes (Smith, 2017 [13]; Becker, 1981 [14]). The educational attainment, with a significant portion completing secondary education, suggests a community with a basic level of literacy, which can be instrumental in awareness campaigns and community engagement initiatives (World Bank, 2018 [15]; Sen, 1999 [16]).

4.2. Level of Community Awareness and Understanding of the River/Wetland

The overwhelming recognition of the river/wetland as a natural resource underscores the community's inherent understanding of their environment. Such awareness is crucial as it can influence conservation attitudes and practices (Turner *et al*., 2015 [17]; Berkes, 2004 [18]). The proximity of a majority of households to the wetland might suggest a direct reliance on its resources, which can be both an opportunity and a challenge for conservation efforts. Long-term residency in the area further indicates a deep-rooted connection with the environment, which can be leveraged for conservation initiatives (Brown & Raymond, 2007 [19]; Adger, 2003 [20]). The qualitative findings from NEMA and the Kenya Forest Service emphasize the importance of accurate knowledge dissemination to address any misconceptions.

4.3. Effectiveness of Land Usage and Ownership Practices near the River/Wetland

The high percentage of land ownership among respondents indicates a sense of permanence and investment in the area. Land tenure security can influence land management practices, with landowners more likely to invest in sustainable practices (Deininger & Jin, 2006 [21]; Feder & Feeny, 1991 [22]). The diverse methods of land acquisition, from inheritance to leasing, highlight the multifaceted nature of land tenure in the region. The predominant use of land for agriculture aligns with the occupation data and underscores the importance of sustainable agricultural practices to ensure the health of the river/wetland (Pretty *et al*., 2006 [23]; Barrett *et al*., 2001 [24]).

4.4. Interaction with the River/Wetland

The data suggests a strong interaction between the community and the river/wetland, with a majority having access to it. The dangers faced, predominantly flooding, highlight the need for risk mitigation strategies and awareness campaigns. The qualitative insights from the Green Belt Movement and the Kenya Forest Service emphasize the importance of understanding local challenges to tailor conservation strategies effectively (Folke *et al*., 2005 [25]; Lebel *et al*., 2006 [26]).

4.5. Sources of Water for the River/Wetland and Their Management Practices

The identification of various water sources, with springs being predominant, provides insights into the hydrological dynamics of the area. The recognition of rivers like Kimondi and Kingwal can be instrumental in targeted conservation efforts. The perception of the river/wetland as perennial suggests a consistent water supply, which can be a crucial resource for the community. However, the management perceptions, with a majority believing in community management, indicate a potential gap between formal governance structures and community perceptions. This aligns with global discussions on the effectiveness of community-based resource management versus centralized approaches (Ostrom, 2009 [27]; Dietz *et al*., 2003 [28]).

5. Conclusion

In Nandi County, the sociodemographic characteristics reveal a balanced age distribution with a slight inclination towards individuals aged 44 years and below. Males predominantly head households, and a significant majority of these household heads are married. Education levels vary, with most having completed secondary education. Farming emerges as the primary occupation, with few households relying on formal employment. The community's awareness of the river/wetland is evident, with most recognizing its natural origin and a significant number residing close to it. The majority have lived in the area for over

15 years, suggesting a deep-rooted connection with the environment. Land ownership is prevalent, with various acquisition methods, including inheritance and purchase. Agriculture dominates land use, reinforcing the community's agrarian nature. Interaction with the river/wetland is significant, with many households having access to it, though they face challenges like flooding. Lastly, the river/wetland's water sources are diverse, including springs and rivers like Kimondi. Community-based management of the river/wetland is the preferred approach, highlighting the community's desire for active involvement in conservation efforts.

Recommendations

1) Community Engagement and Education: Given the high level of community awareness and understanding of the river/wetland, there's an opportunity to further engage the community in conservation efforts. Educational programs can be introduced to enhance their knowledge and address any misconceptions.

2) Promotion of Sustainable Farming: With a significant majority of households engaged in farming, promoting sustainable agricultural practices can help preserve the river/wetland ecosystem. This includes introducing organic farming, crop rotation, and water conservation techniques.

3) Land Ownership and Management: The study indicates a complex land tenure system. It's essential to streamline land ownership and usage rights, ensuring that conservation efforts are not hampered by land disputes.

4) Infrastructure Development: For those who face challenges accessing the river/wetland, developing proper infrastructure, such as access roads, can help. This will ensure that the community can utilize the resources without causing environmental degradation.

5) Flood Mitigation: Given that flooding is a significant concern for many households, introducing flood mitigation measures, such as constructing levees or introducing early warning systems, can help protect both the community and the environment.

6) Wildlife Conservation: While encounters with wild animals are rare, it's essential to have measures in place to protect both the wildlife and the community. This could include awareness campaigns about local wildlife and setting up safe zones for animals.

7) Water Resource Management: With most households recognizing the river/wetland as a perennial source, there's a need to ensure its sustainability. Regular monitoring of water quality, introducing measures to prevent pollution, and ensuring that water extraction is sustainable are crucial.

8) Community-based Management: The community's preference for community-based management of the river/wetland should be honored. Establishing community-led committees or groups can ensure that the river/wetland is managed in a way that benefits both the environment and the local population.

9) Collaboration with Local Authorities: While the community plays a vital role, collaboration with local and national authorities is essential. This can ensure that conservation efforts are supported by policies, regulations, and necessary resources.

10) Continuous Research and Monitoring: To ensure that conservation efforts are effective, continuous research and monitoring of the river/wetland are essential. This will help in understanding the changing dynamics and adapting strategies accordingly.

Declarations

The authors declare that they have no conflicts of interest or financial interests that could influence the research or its interpretation. This research adheres to ethical guidelines and principles for scientific research, and all data collection and analysis were conducted with the highest level of integrity and transparency.

Funding

This study was generously funded by The Nature Conservancy (TNC), an international non-profit organization dedicated to conserving the lands and waters on which all life depends. The financial support provided by TNC was instrumental in carrying out the fieldwork, data collection, laboratory analysis, and publication of this research. The funding played a crucial role in advancing our understanding of the Yala River watershed and contributed to the development of effective nature-based conservation measures.

Conflict of Interests

The authors hereby disclose that there are no competing interests associated with this research. The study was conducted with a commitment to scientific objectivity and impartiality, and there were no external influences that could compromise the integrity of the research or its findings.

Disclaimer

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect the official policy or position of The Nature Conservancy or any other affiliated organization. The information presented in this research is based on the data collected and analyzed at the time of the study and is subject to change with future developments or further research.

The authors have made every effort to ensure the accuracy and reliability of the data and findings presented in this publication. However, they are not liable for any errors, omissions, or misinterpretations that may arise from the use of this information. Readers are encouraged to use this research as a foundation for further investigations and consult additional sources for comprehensive insights into the Yala River watershed and its conservation.

References

[1] Dudgeon, D., *et al.* (2006) Freshwater Biodiversity: Importance, Threats, Status and Conservation Challenges. *Biological Reviews*, **81**, 163-182. https://doi.org/10.1017/S1464793105006950

[2] Vörösmarty, C.J., *et al.* (2010) Global Threats to Human Water Security and River Biodiversity. *Nature*, **467**, 555-561. https://doi.org/10.1038/nature09440

[3] Ongugo, R.O., *et al.* (2014) Participatory Forest Management in Kenya: Is There Anything to Learn from Bénin and Nepal? *Unasylva*, **241**, 46-53.

[4] Githeko, A.K., *et al.* (2009) Climate Change and Vector-Borne Diseases: A Regional Analysis. *Bulletin of the World Health Organization*, **78**, 1136-1147.

[5] Jenkins, W.A., Murray, B.C., Kramer, R.A. and Faulkner, S.P. (2010) Valuing Ecosystem Services from Wetlands Restoration in the Mississippi Alluvial Valley. *Ecological Economics*, **69**, 1051-1061. https://doi.org/10.1016/j.ecolecon.2009.11.022

[6] Turner, R.K., *et al.* (2015) Ecosystem-Based Management. In: *Ecosystem Services: Global Issues, Local Practices*, Elsevier, Amsterdam, 67-77.

[7] Berkes, F. (2009) Evolution of Co-Management: Role of Knowledge Generation, Bridging Organizations and Social Learning. *Journal of Environmental Management*, **90**, 1692-1702. https://doi.org/10.1016/j.jenvman.2008.12.001

[8] Sala, O.E., *et al.* (2000) Global Biodiversity Scenarios for the Year 2100. *Science*, **287**, 1770-1774. https://doi.org/10.1126/science.287.5459.1770

[9] Adger, W.N., *et al.* (2005) Social-Ecological Resilience to Coastal Disasters. *Science*, **309**, 1036-1039. https://doi.org/10.1126/science.1112122

[10] United Nations (2019) World Population Prospects.

[11] Doss, C. (2013) Intrahousehold Bargaining and Resource Allocation in Developing Countries. *The World Bank Research Observer*, **28**, 52-78. https://doi.org/10.1093/wbro/lkt001

[12] Agarwal, B. (1997) "Bargaining" and Gender Relations: Within and beyond the Household. *Feminist Economics*, **3**, 1-51. https://doi.org/10.1080/135457097338799

[13] Smith, L.C. (2017) The Importance of Women's Status for Child Nutrition in Developing Countries. International Food Policy Research Institute, Washington DC.

[14] Becker, G.S. (1981) A Treatise on the Family. Harvard University Press, Cambridge.

[15] World Bank (2018) World Development Report: Learning to Realize Education's Promise.

[16] Sen, A. (1999) Development as Freedom. Oxford University Press, Oxford.

[17] Turner, R.K., Paavola, J., Cooper, P., Farber, S., Jessamy, V. and Georgiou, S. (2015) Valuing Nature: Lessons Learned and Future Research Directions. *Ecological Economics*, **46**, 493-510. https://doi.org/10.1016/S0921-8009(03)00189-7

[18] Berkes, F. (2004) Rethinking Community-Based Conservation. *Conservation Biology*, **18**, 621-630. https://doi.org/10.1111/j.1523-1739.2004.00077.x

[19] Brown, G. and Raymond, C. (2007) The Relationship between Place Attachment and Landscape Values: Toward Mapping Place Attachment. *Applied Geography*, **27**, 89-111. https://doi.org/10.1016/j.apgeog.2006.11.002

[20] Adger, W.N. (2003) Social Capital, Collective Action, and Adaptation to Climate Change. *Economic Geography*, **79**, 387-404. https://doi.org/10.1111/j.1944-8287.2003.tb00220.x

[21] Deininger, K. and Jin, S. (2006) Tenure Security and Land-Related Investment: Evi-

dence from Ethiopia. *European Economic Review*, **50**, 1245-1277. https://doi.org/10.1111/j.1944-8287.2003.tb00220.x

[22] Feder, G. and Feeny, D. (1991) Land Tenure and Property Rights: Theory and Implications for Development Policy. *The World Bank Economic Review*, **5**, 135-153. https://doi.org/10.1093/wber/5.1.135

[23] Pretty, J., Toulmin, C. and Williams, S. (2006) Sustainable Intensification in African Agriculture. *International Journal of Agricultural Sustainability*, **9**, 5-24. https://doi.org/10.3763/ijas.2010.0583

[24] Barrett, C.B., Reardon, T. and Webb, P. (2001) Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications. *Food Policy*, **26**, 315-331. https://doi.org/10.1016/S0306-9192(01)00014-8

[25] Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005) Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, **30**, 441-473. https://doi.org/10.1146/annurev.energy.30.050504.144511

[26] Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P. and Wilson, J. (2006) Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. *Ecology and Society*, **11**, 19. https://doi.org/10.5751/ES-01606-110119

[27] Ostrom, E. (2009) A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science*, **325**, 419-422. https://doi.org/10.1126/science.1172133

[28] Dietz, T., Ostrom, E. and Stern, P.C. (2003) The Struggle to Govern the Commons. *Science*, **302**, 1907-1912. https://doi.org/10.1126/science.1091015