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Original Research Article

Community Benefits Derived from the Ecosystem Services of Marura Wetland

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Abstract

Wetlands are one of the most important ecosystems, providing a number of fundamental services to the environment and local communities. Notwithstanding this great value, wetlands everywhere in the world face some challenges due to human activities that involve agricultural expansion, urbanization, pollution, and climatic change. Therefore, this study assessed the various ecosystem services provided by the Marura Wetland to the local community. The study was guided by Tragedy of the Commons theory and employed a cross sectional survey approach. The study area stretched between Koilel and Kaprobu Bridge along Eldoret- Ziwa Road. Stratified random sampling was used to select 200 households from the region. Data was coded into SPSS version 23 and analysed using descriptive and inferential statistics. Water (97%), papyrus reeds (70.5%), and bricks (68.2%) were the main products from the wetland. 80% of respondents felt the

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wetland was nearing its capacity to support the local population, 76% agreed humans have the right to use the environment to meet their needs, and 74% believed local communities were significantly abusing the wetland, often leading to disastrous consequences. However, it also notes increases in human pressures within the wetland due to overgrazing, soil mining, and other exploitative activities that are threatened or have already reduced the sustainability of the wetland. The findings recommend increasing community awareness on the sustainable use of Marura Wetland through active conservation groups and educational programs, and implementing stricter regulations and monitoring to prevent further environmental degradation.

Keywords: Wetland, Ecosystem Service, Community, Benefits, Marura

Introduction

Wetlands include both freshwater and marine coastal ecosystems, including lakes, rivers, underground aquifers, swamps, marshes, wet grasslands, peatlands, oases, estuaries, deltas, tidal flats, and coastal areas like mangroves and coral reefs (Ayyam et al., 2019; Gupta et al., 2020; Nayak & Bhushan, 2022; Balwan & Kour, 2021). They also include human-made environments such as fishponds, rice paddies, reservoirs, and saltpans (Yousuf Haroon & Kibria, 2017; Lamsal et al., 2017).

Wetlands offer several benefits to communities, making their sustainable use and conservation critical for social, economic and environmental development. Rice is a staple for nearly 3.5 billion people and is grown in wetland paddy fields (Gadal et al., 2019). Most commercially important fish species also breed in coastal wetlands, and are essential to maintain fish populations (Kraufvelin et al., 2018; Newton et al., 2020; Balwan & Kour, 2021). This, in turn, supports communities relying on fishing as a source of food and revenue. Wetlands also contribute to food security through the provision of water for irrigation of crops, utilizing about 70% of the freshwater drawn off globally (Sharma & Singh, 2021). They also, act as natural reservoirs that ensure the availability of fresh water (Gupta et al., 2020). They help replenish groundwater aquifers, maintaining water supplies in times of drought (Scanlon et al., 2023; Mohil et al., 2022. Furthermore, wetlands naturally filter and purify water by trapping harmful substances like fertilizers, pesticides, heavy metals, and toxins from industrial activities, improving water quality for surrounding communities (Balwan & Kour, 2021). Furthermore, wetlands function as natural sponges, absorbing rainfall and reducing the impact of coastal and river flooding hence providing a natural defense against floods, reducing the need for costly man-made flood infrastructure (Gaber,

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2020). Wetlands also provide cultural benefits, including knowledge, recreation, tourism, and the formation of cultural and spiritual values (Lew & Wu, 2017; Barbier, 2011).

Around the world, the degradation and loss of wetlands have resulted in diminished livelihood opportunities, increased social conflicts and human displacement (Bezabih & Mosissa, 2017; Mitchell, 2013; Giweta & Worku, 2018). Factors contributing to this include rapid population growth, unsustainable production and consumption practices, invasive species, technological advancements, and the negative effects of climate change (George, 2020; Mao et al., 2018; Ong'anya, 2024). Also, ecosystem modifications, such as irrigation, can reduce wetland benefits like water supply or fish, requiring a balance between conservation and development (Bassi et al., 2014).

In Kenya, agricultural activities, particularly around Lake Naivasha and the Yala Swamp, have led to the conversion of wetlands into farmlands (Okech, 2016; Kemunto, 2018). Wetland drainage for large-scale flower farming around Lake Naivasha has reduced the wetland's ability to filter pollutants, contributing to eutrophication and habitat loss (Otiang'a-Owiti & Oswe, 2007). According to the Ngodhe et al. (2016), water over-abstraction has altered the natural hydrology of wetlands, reduced their ecological function and led to the loss of biodiversity. Wetlands near urban centers in Kenya, such as Nairobi's Ondiri Swamp, are under pressure from urban encroachment and pollution. Industrial waste, sewage, and solid waste have polluted wetlands, affecting water quality and ecosystem health (Miriti, 2016). Kenya's wetlands are increasingly affected by climate change, particularly in arid and semi-arid areas. The reduction of rainfall and prolonged droughts have resulted in the drying up of key wetlands, such as Lake Kamnarok (Renaut & Owen, 2023).

The Marura Wetland is considered an integral component of Kenya's wetland network, a system that provides an array of important resources for livelihood support. However, it is also one of the many wetlands facing increased stresses from human activities that degrade it, thus diminishing its potential to provide these important ecosystem services. The sustainability of wetlands is therefore a sure way of ensuring that such benefits are maintained. This study analyzed ecosystem services at Marura Wetland, threats from human activities, and strategies for sustainable management.

Theoretical Framework

The study was guided by the Tragedy of the Commons theory, developed by Garrett Hardin in 1968 (Oakes, 2016). This theory has been used to explain environmental issues like deforestation, overfishing, soil erosion, depletion of wetland resources, and overgrazing of rangelands (Libecap,

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2009). According to the model, for a tragedy to occur, three conditions must be fulfilled. Firstly, the resource must be owned in common by a group of people (common property and must be open to any user (open access)). Secondly, the user must be selfish. Individuals pose self-interest as opposed to collective good and thirdly the resource must be used so intensively that the rate of exploitation exceeds the natural rate of replenishment of the resource (Hardin 1968). According to Hardin's model, such resources held in common are doom to over-exploitation since each resource use places immediate self-interest above community interest. This way, the model makes a critical assumption that resource users are individualistic and unable to cooperate towards the greater community interest. Thus, they eventually become both villain and victims of resource depletion.

Lloyd (1968) identified the problem of "externalities" people are unlikely to retain their behavior when the immediate benefits of their actions are theirs but the costs are passed onto society as a whole or others, and any benefit that may occur from an individual's effort to conserve are indiscernible". The tragedy of the commons proposes the freedom in the utilization of a common property resources results in a tragedy that brings ruin to all as each's consequences of overexploiting the resources. The theory is concerned with the utilization of common property resource and its depletion over time in which those involved know that a disaster is coming but are unable to do anything about it (Arnold, 1998). Marura is a common resource and, therefore, common property regime is inimical to the sustainable management of resources as it leads to overuse of the resources.

In these illustrations, degradation can be achieved by studying the anthropogenic activities within the study site and the change in spatial extent of the swamp by using satellite images. This is arrived at based on Hardin's study on 'tragedy of the commons'-that humans deplete commonly shared resources faster than individually or privately managed resources. This is also affected by some factors called the intervening factors which are the prime causes of swamp size decrease or increase. They will be a future prediction on swamp size and provide a mitigation measure based on observation and findings from the research to enhance environmental sustainability of the swamp.

Methodology

The study employed a cross-sectional research design. According to Cooper and Schindler (2008), cross-sectional study (also known as a cross-sectional analysis, transversal study, prevalence study) is a type of observational study that involves the analysis of data collected from a population, or a representative subset, at one specific point in time. This was

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an appropriate research design for this study as it aims at producing accurate information desired to be collected at that particular time.

According to Mugenda and Mugenda (2003), target population is a population to which a researcher would like to generalize the result of the study. The population for the study was drawn from the population living within the catchment of the swamp area, which covers 210 km^2. This included residents engaging in various activities within the swamp. It also targeted key informants made up of the Uasin Gishu County executive in charge of the Ministry of Environment, water and natural resources representative from NEMA. In total, the target population for this study was 21, 831 as per population census of 2009.

The sample sizes were obtained using Yamane's formulae;

$$n = \frac{N}{[1 + Ne^2]}$$

$$n = [1 + Ne^2]$$

Source: *Yamane (1967)*
Where n= Sample size,
N=Population size,
e=Sampling error

Table 1: Sample Size Calculation

Location	**Population Size (Number of Households)**	**Sample size using Yamane's Formula**
Upper zone	2227	$n=N/(1+Ne^2)$
Kaptagat	1282	$n=(5443/1+5443\times0.1^2)$
Tembelio		$n=5443/55.43=98.195$
Mid Zone	855	$n=10945/(1+10945\times0.1^2)$
Elgeyo Border	1079	$n=10945/110.45=99.09$
Sergoit	5443	$n=99.09$
Lower Zone	3,568	
Chepkoilel/Kimumu/Chepkoilel		
	10945	
Total Population		197.85 ≈ 198 Respondents

Source: *Researcher* 2018

Stratified random sampling was used to sample out all the 198 households living along the wetland. The total sample size was therefore was

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200 respondents. The study area was purposefully stratified depending on the type and intensity of human activity along the wetland.

As a method of data collection, structured questionnaires involve asking rather than observing the respondents. The use of questionnaires enabled the interviewee to gather data over a large sample spread within the wetland. The researcher developed structured questionnaires to gather information form the local community on the products and services they receive from Marura wetland as well as their use of the land along Marura wetland.

Collected data was tabulated and analyzed for descriptive statistics with the help of SPSS version 20 for windows was used to analyze qualitative data obtained from questionnaires. The means and mean percentages were determined to help make valid conclusions and probable recommendations. The analyzed data was presented in tables, charts, graphs and narratives

Results and discussions

Age of the Respondents

The study of the respondents and presented the findings as shown on Figure 1

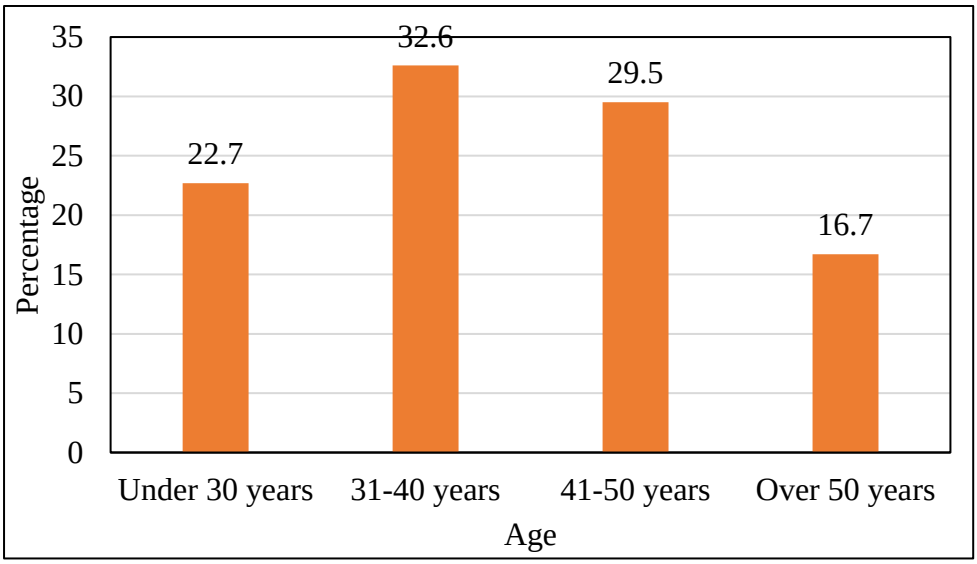

Figure 1: Age of the Respondents
Source*: Author's Data, (2018)*

The study indicates that 43 (22.7%) were under 30 years, 62 (32.6%) were aged between 31-40 years, 56 (29.5%) were aged between 41-50 years while 32 (16.7%) were aged over 50 years. Majority of the respondents were aged between 31-40 years. The purpose of establishing the ages was to

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ensure that the study collects information from respondents of diverse ages to satisfy the quality of the study.

Gender of the Respondents

There were 82(62.5%) male respondents and 50(37.5%) female respondents. The purpose of checking the gender of the respondents was to ensure that there was no bias in terms of gender on the information given.

Marital Status of the Respondents

The informants interviewed 169 (87.5%) were married, 21 (10.7%) were single while three where widowed. There were no divorced or others in this category. Majority of the respondents were married. The reasons for the marital status were to establish balance in information needed for the study in terms of marital status.

Education Level of the Respondents

The study also assessed the level of education of the respondents and presented the summarized response in figure 2 below.

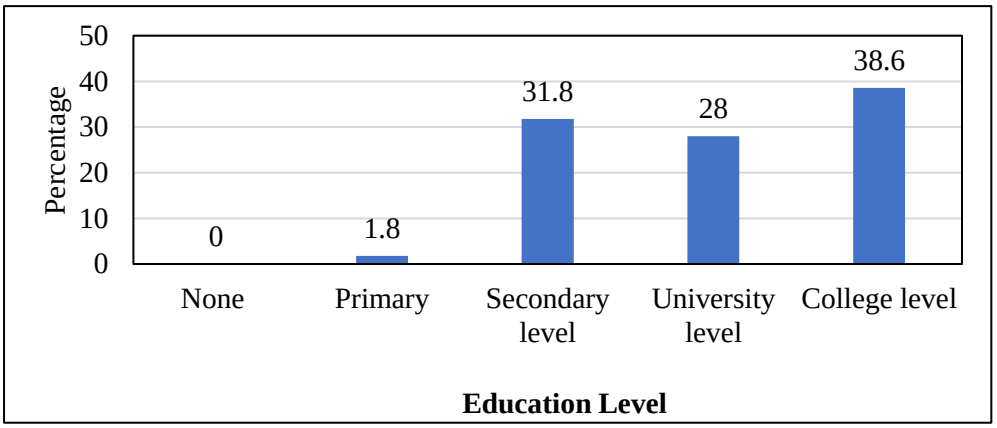

Figure 2: Level of education of the Respondents
Source*: Author's Data, (2018)*

There were no respondents who had not gone to school. Three (1.8%) had attained primary level, 61 (31.8%) secondary level, 54 (28%) were of the respondents were of university level while75 (38.6%) of the respondents were of college. Majority of the respondents were of college level of education. It was important to establish the academic qualifications of the respondents to achieve the quality and the validity of the study.

Occupation of the Respondents

Figure 3 present the findings on the occupation of the respondents.

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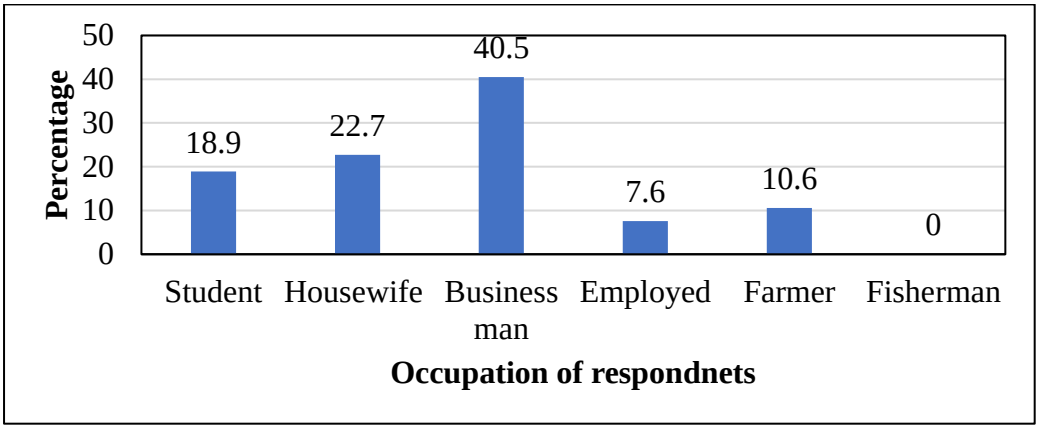

Figure 3: Occupation of the Respondents in study area
Source*: Author's Data, (2018)*

The study shows 36 (18.9%) of the respondents were students, 44 (22.7%) of the respondents were housewives, 78 (40.5%) of the respondents were businesspersons, 15 (7.6%) were employed while 20 (10.6%) were farmers. There were no fishermen. Majority of the respondents had experiences of between 4-7 years. The purpose of determining the occupation of the respondents was to ensure that the study collects information from different respondents with different occupation. This was to ensure there is no bias in terms of occupation.

Average Monthly Income of the Respondents

The study also assessed the average monthly income of the respondents and presented the findings in figure 4 below.

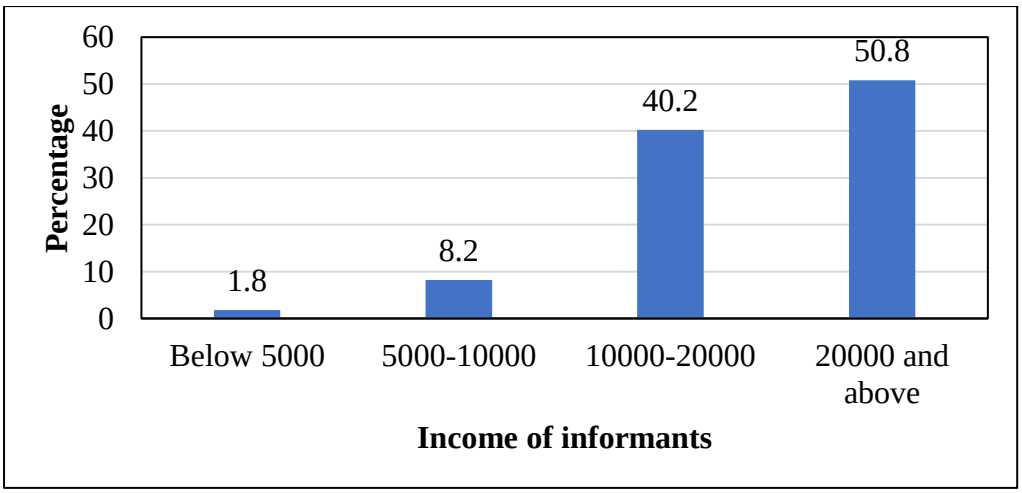

Figure 4: Income of the Respondents in Marura swamp
Source*: Author's Data, (2018)*

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The study shows that three (1.8%) earned incomes of below 5,000, 16 (8.2%) earned income of 5,000-10,000 shillings, 78 (40.2%) earned incomes of 10,000-20,000 while 96 (50.8%) earned incomes of 20,000 and above. Majority of the respondents earned income of 20,000 and above. The study collected data about income of the respondents so as to establish the extent to which the residents along Marura wetland benefited economically from the wetland apart from their normal salary.

Length of Stay in the Study Area

From the study, 78 (40.2%) had lived there for a period below 5 years, 73 (37.9%) had been there for 6-10 years, 34 (17.4%) had lived there for between 11-20 years, 8 (5.5%) had lived in Marura for between 21-30 years while there were no respondents who had lived there for above 30 years. Majority of the respondents had lived in Marura for below 5 years. The purpose of determining the period the respondents have lived in Marura was to ensure that the study collects information from different informants on the duration of their stay in the area; this was to ensure there is no bias in terms of period of living.

Size of Land owned by respondents in Marura

Figure 5 presents the distribution of land ownership among respondents in the Marura Wetland area. It provides insight into the size of land owned by the local community members, which is a key factor in understanding the relationship between land use practices and the sustainability of the wetland. This data helps assess how land ownership patterns may influence the pressure on wetland resources and the overall impact of human activities on the ecosystem.

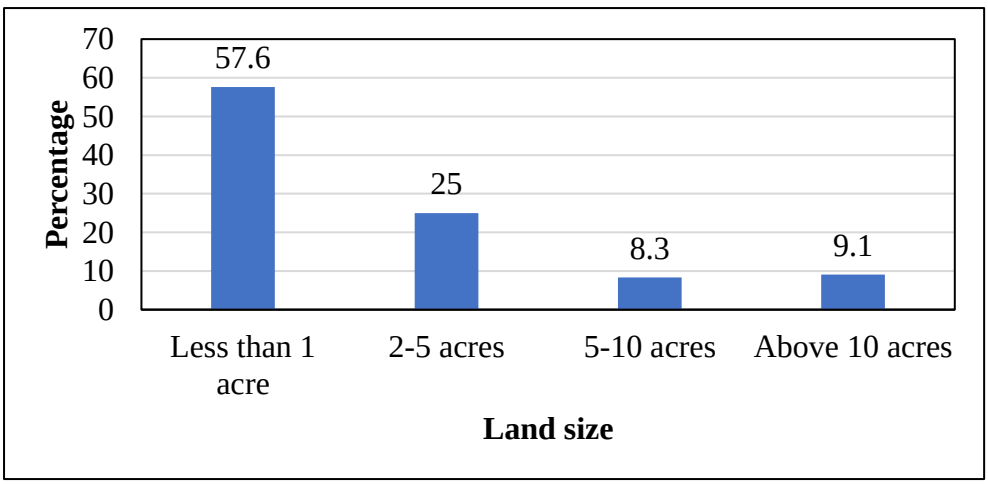

Figure 5: Size of Land owned by respondents in Marura
Source*: Author's Data, (2018)*

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Survey findings indicate that 111 (57.6%) had less than one acre, 48 (25%) had 2-5 acres, 16 (8.3%) had 5-10 acres while 18 (9.1%) had above 10 acres. It was important to assess the sizes of land of the respondents so as to get a clear view of the land use in the area to enrich the study.

Goods Obtained from Marura Wetlands

Figure 6 illustrates the variety of goods obtained from the Marura Wetlands by the local community.

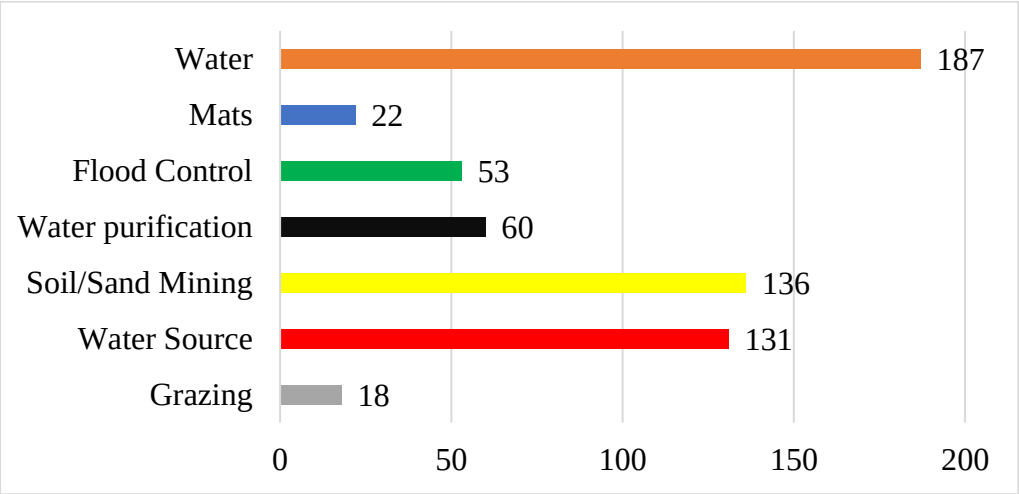

Figure 6: Goods Obtained from Marura Wetlands
Source*: Author's Data, (2018)*

The findings show that water is the most essential good the local community obtain from Marura wetland at 97%. This is consistent with findings from studies on the Yala Swamp (Maua et al., 2022) and Lake Naivasha (Omondi et al., 2015), which also pointed out that local communities heavily depend on wetlands as a key water source, particularly in regions where access to clean and reliable water is scarce.

The harvesting of papyrus reeds (70.5%) and bricks (68.2%) in Marura Wetland reflects similar patterns seen in other Kenyan wetlands, such as the Yala and Tana Delta wetlands. In these regions, papyrus is commonly used for making mats, crafts, and roofing materials, contributing to local economies (Onganya, 2023).

The collection of brooms (31.1%) and firewood (27.3%) from Marura Wetland also mirrors findings from studies conducted in wetlands such as Kusa wetland in Kisumu (Atieno, 2012). The relatively low percentage of respondents obtaining medicinal plants (9.1%) from Marura Wetland is consistent with findings from Kenyan studies, which show that while wetlands provide valuable medicinal resources, the knowledge and use of traditional

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medicines are declining. Research in areas such as the wetlands of Loboi Plains in Baringo County (Kareri, 2018) suggests that although wetlands offer medicinal plants, the availability of modern healthcare services and the erosion of indigenous knowledge have led to a decline in the use of wetland-sourced medicines.

Perceived importance of Marura Wetland

Figure 7 illustrates the perceived importance of the Marura Wetland as expressed by the local community.

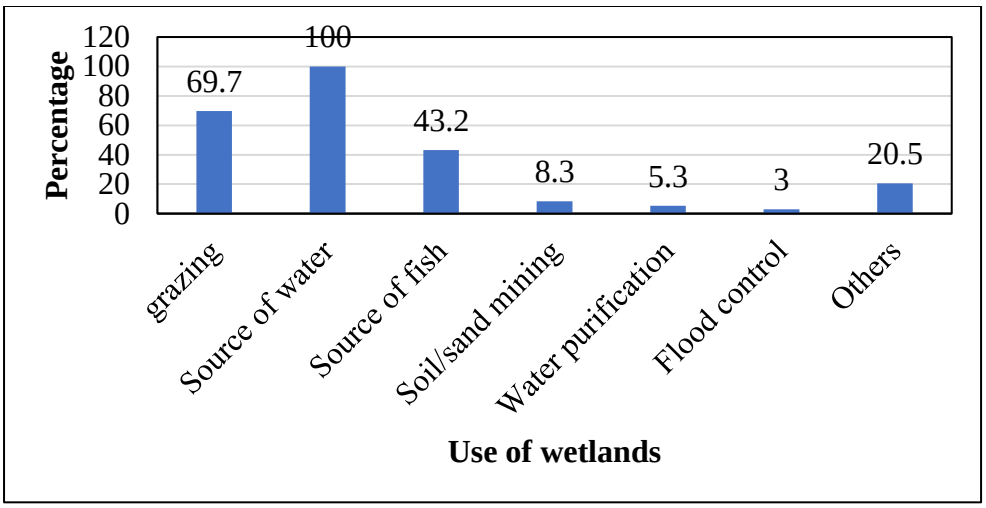

Figure 7: Perceived Importance of Marura Wetland
Source*: Author's Data, (2018)*

The study indicates that 193 (100%) of the respondents were of the opinion that the most important aspect of the wetlands in the community is that it is the water source. This could be because of the fact that most communities living near wetlands depend on them for water source and also water their animals from the wetland. The other perceived importance includes; grazing (69.7%), source of fish (43.2%), soil/sand mining (8.3%), water purification (5.3%) and flood control (3%). The findings point out the critical role of wetlands in supporting local communities, particularly as sources of water, grazing land, and fish. This is consistent with research on Kenya's Tana River Delta, which highlights the wetland's importance for pastoral, agricultural, and fishing communities who depend on its resources for their livelihoods (Wetlands International, 2015). Similarly, the Yala Swamp Wetland provides essential resources such as water, fish, and fertile land for agriculture, underpinning the livelihoods of surrounding communities (Onganya, 2023). The reliance on wetlands for water purification and flood control, though less recognized by the community in the study, is well-

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documented in other Kenyan contexts. For instance, the Nyando Wetland is noted for its role in water purification and flood mitigation, providing essential ecosystem services that benefit local populations (Rongoei et al., 2013). However, activities such as soil and sand mining, while offering economic opportunities, can lead to wetland degradation if not properly managed. The Sio-River Wetland in Busia County faces similar challenges, where human activities have impacted its sustainability (Odaya et al., 2023).

Source of Information on the Importance of Marura Wetland

The researcher sought to find out from the respondents how they had come to understand the importance of Marura wetlands. Table 2 below presents the findings.

Table 2: Source of Information on the Importance of Marura Wetland

Source	Frequency	Percentage
Radio	145	74.2
Newspaper	16	8.3
Chief's Baraza	6	3.2
Wetland day celebration	2	0.75
TV stations	14	7.5
Others	10	5.3
Total	**193**	**100**

Source: Author's Data, (2018)

Data in Table 2 show the various sources through which respondents have gained information on the importance of the Marura Wetland. It is dominated by radio broadcast sources, where 145 persons have informed about it, constituting 74.2%, followed by television stations, where 14 respondents were informed, at 7.5%. Newspapers were mentioned by 16 participants at 8.3%, whereas Chief's Baraza - community meetings - were noted by 6 respondents at 3.2%. Wetland Day celebrations and others were the least mentioned at 2 (0.75%) and 10 (5.3%) respectively. These results highlight the significance of the mass media, radio, and television in imparting information relating to wetland conservation among community members. Community gatherings and events are not being used to a great extent, as commemorated by the infrequent mentions of these channels.

Attitude of the Respondents towards Environmental Integrity

The community attitude toward environmental integrity is always important to understand if any conservation initiative is to be effectively addressed. Table 3 presents attitudes of the respondents towards environmental integrity in Marura Wetland, hence showing what they perceive and are concerned about regarding this very important ecosystem.

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Table 3: Attitude of the Respondents towards Environmental Integrity

Item		5	4	3	2	1
We are approaching the limit of the number of people that Marura wetlands area can support.	%	25	54.8	7.1	7.1	8.9
Humans have the right to modify the natural environment to suit their need.	%	26.8	39.3	14.3	5.4	14.3
When humans interfere with nature, it often produces disastrous consequences	%	23.2	39.3	12.5	14.3	11.7
Local communities are severely abusing the wetlands	%	30.4	26.8	14.3	12.5	16.1
The earth has plenty natural resources if we just learn how to develop them.	%	17.9	44.6	7.1	14.3	16
Plants and animals have as much rights as human beings to exist	%	17.9	44.6	7.1	14.3	16

Key; F- frequency %- percentage 5-strongly agree, 4-agree, 3-undecided, 2-disagree, 1-strongly disagree, T-total
Source: Author's Data, (2018)

The study indicates that 80% of the respondents were of the opinion that they are approaching the limit of the number of people that Marura wetlands area can support. Similar observations have been made in studies on Kenya's Yala Swamp and the Lake Victoria basin, where population pressure has resulted in increased agricultural activities, water abstraction, and habitat loss (Onganya, 2023).

The belief held by 76% of respondents that humans have the right to modify the natural environment reflects an anthropocentric view, commonly seen in resource-dependent communities. The attribute is commonly linked with the overexploitation of ecosystems where economic needs are set in priority over environmental sustainability. For example, wetland modification into agriculture and settlement has been translated by the communities of the

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Tana River Delta in a manner that is considerably degrading to the area of interest. (Wetlands International, 2018).

The opinion that 74% of respondents responded that local communities are severely abusing the wetlands and that human interference often leads to disastrous consequences. Human activities such as overgrazing, water abstraction, and unsustainable agricultural practices have been well-documented as major contributors to wetland degradation in areas like the Sio-Siteko wetland in Western Kenya (Ocholla et al., 2013).

The idea expressed by 70% of respondents, that the earth has plenty of resources if developed sustainably, is consistent with the global narrative on sustainable development. This aligns with broader conservation strategies that advocate for the protection of both biodiversity and human well-being, as seen in Kenya's Ramsar-listed wetlands like Lake Nakuru and Lake Bogoria (Ramsar Convention, 2020).

Conclusion and recommendation

This study identifies that Marura wetland has much to contribute in terms of provision of key goods and services, especially water, which is one of the most essential commodities to the local communities. However, it also notes increases in human pressures within the wetland due to overgrazing, soil mining, and other exploitative activities that are threatened or have already reduced the sustainability of the wetland. The dependence of the community on wetlands for livelihood activities, in addition to attitudes towards environmental integrity, calls for a balance in resource management.

The findings recommend increasing community awareness on the sustainable use of Marura Wetland through active conservation groups and educational programs, and implementing stricter regulations and monitoring to prevent further environmental degradation. There is also the need for community to undertake the restoration of degraded areas of the wetland, which could help in keeping up ecological balance and ensuring the perpetuation of the provision of basic goods and services.

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