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Original Article

## Effects of Human Settlements on the Conservation of Sondu River Basin, Kenya

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Governments and environmental conservationists agree that wetland resources need to be utilized sustainably to ensure the continued presence of wetlands and their ecological goods and services. Ideally, wetlands should be integrated into the national and local land use plans to ensure sustainable use and management of the resources. However, this is not the case as far as Kenya is concerned. Instead, there is rampant exploitation of wetlands by individuals, organizations and even government agencies with no regard to environmental conservation. Therefore, this study was undertaken to investigate the impact of human activities on wetland conservation with a focus on the Sondu River Basin. The objective of the study was to establish the effects of human settlements on the conservation of the Sondu River Basin. The study was grounded on the integrated water resource management theory. This study adopted a concurrent triangulation research design which entailed a combination of both qualitative and quantitative data. The target population for the study was 164 respondents in which a sample of 144 respondents was selected using Slovin's formula. The sample was randomly selected with the inclusion criterion being that the chosen respondents were homogeneously engaged in human activities that affected wetland conservation. Intensive data cleaning exercise was carried out including checking for outliers, missing data imputation and variable transformation. The collected data were analysed by use of descriptive statistics such as frequencies, percentages and summation and presented in the form of tables and charts. The results of the study will inform policy and practice in the management and conservation of the Sondu River wetland area. The study established that human activities such as farming, logging, construction, drilling, building and construction and settlements have

immensely hampered conservation of Sondu wetland. Further, it was noted that it is indeed possible to gain vital information about the human activities responsible for the degradation of wetlands.

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## INTRODUCTION

The conservation of wetlands has become a critical issue in contemporary society because the human population is growing exponentially, thus putting pressure on existing natural resources. Wetlands deliver practical benefits to plants, animals, humans, and the overall ecosystem or bio-diversity (Roy, Jane & Venema, 2011). Coastal and inland marshes, for example, is the upbringing, latent, and wintering environments for thousands of wandering birds, including ducks, geese, swans, shorebirds, herons, and other wading birds.

Wetlands are critical to the sufficiency of humans in the precinct of welfare activities of the communities living in the environment, which includes the water sanitation, flow regulations and management of critical water resource, forest covers for management of carbon blueprint and management of conservations and water management. According to the Ramsar Convention International List, there are 1,952 wetlands, which cover a total surface area of 1.9 million km<sup>2</sup> in the United States (Ramsar Convention Secretariat, 2010).

Given the ecological importance of wetlands and the growing threats to environmental conservation today, various concerns have been raised globally over the state of the environment. Rebelo *et al.* (2010) outlined both global and regional initiatives that have been deployed to save wetlands from human activities. Among these concerns and efforts were the Rio-de-Janeiro Conference (1992), the Kyoto Protocol of 1995 and the Copenhagen Climate Meeting of 2009, all of which underlined that global and regional climate changes are a threat to land resources on which human survival relies (Rebelo *et al.*, 2010). The existence of wetlands is under threat due to alarming human infringement and it is estimated that more than 50% of the world's inland wetlands have been lost. Much of this loss of wetlands worldwide is attributed to agricultural activities. In a profound sense, it is estimated that the loss of 56-65% of existing wetlands in Europe and North America, 27% in Asia, 6% in South America and 2% in Africa is due to agricultural activities (Day *et al.*, 2003).

In the US, Behemoth *et al.* (2003) assert that agricultural practices are the major source of pollution for most rivers. This matter is related to rivers, lakes, streams and springs found in the wetlands, which have serious relations with the

cause of poor farming practices resulting in pesticides, fertilizers and industrial and wastewater discharges. A study by Ausseil et al. (2008) managed to portray the real risks of losing wetlands as have been witnessed in New Zealand, which has lost 90.0% of wetland, where the nation had over 2.4 million hectares and now only 250,000 hectares remains

Ahidur (2016) inspected the influence of human activities on wetlands in India. He found that the use of chemical fertilizers and pesticides in the agricultural fields around the wetlands are the major causative factors of wetland degradation and subsequent water pollution. Other harmful human activities were found to be the construction of houses, roads, agricultural land, and overfishing, among others. Ahidur concluded that the area cover of wetlands is decreasing day by day due to human encroachment, pollution, overgrazing and invasion of species. Wetlands are not wastelands, but play a role in promoting cultural, economic, aesthetic, and spiritual roles. According to Ahidur (2016), wetlands are the world's most threatened habitats due to accelerated drainage, land reclamation, pollution, and over-exploitation of wetland species. He proposes that the classification of wetlands as wastelands should be avoided as wetlands play an important biological, cultural, economic, aesthetic, and spiritual role.

Wetland degradation and loss are attributed to natural factors mainly, human activities, such as agriculture, industrial development, urbanization, pollution, and human settlements. Safari et al. (2012) research-based on the valuation of the effect of human activities on degradations in Nyaruzinga. Wetland in Bushenyi District, South Western Uganda found that water quality is most affected pollution, which ends up contaminating the wetlands. Other major human activities that affect wetlands in Kenya pertains change in land use patterns normally associated with population and settlements in rural Kenya (Matano et al., 2015). Such a phenomenon has been attributed to the problem associated with the Mau forest complex since human settlements have been encouraged by the change of land use. The aftermath has been diminishing forest cover, erosions, decreased soil cultivation quality, loss of vegetation's and rivers

and all in what can be described as ecological instability in the region

In Kenya, a study by Wawira (2012) singled out over-extraction of water using water pumps and encroachment of river banks for agricultural purposes as the main human activities contributing to disharmony between the community, biodiversity and the Ondiri wetland natural resources. It was concluded that the outcome of human activities has led to environmental degradation and the respondents concurred that the wetland could as well become extinct soon. Grazing and farming were the other human activities mentioned by respondents in the entire study area. Muchiri's findings concurred with those of Macharia et al. (2010) reporting that the natural resources around the rural landscape within developing countries provide a variety of economic and environmental security for the whole community.

## **THEORETICAL FRAMEWORK**

### **Integrated Water Resource Management Theory**

The study proposed to use the integrated water resources management theory propounded Al Radif (1999). The building block of this theory is sustainable wetland utilization through allocation, developing and maintaining water possessions in the context of community, monetary and ecological factors. This theory is also supported by the Global Water Partnership which supports and help in the coordination of water, land, and related resources.

Similarly, Roy, Jane and Venema (2011) are of the view that this theory critical since it elevates participatory management of wetlands. The theory can create awareness and elevates the financial aspect of wetlands by defining wetlands as assets having financial form. Therefore, the benefit of this theory is its ability to portray integrated water resources management as a structured approach in the management of wetland resource to encourage sustainable exploitation of wetland.

Jeffrey and Gearey (2006) suggest a compromise between the use of water resource to sustain society but also as an economic base, therefore, water should be used in such a way that it promotes the

creation of wealth and at the same time be sustainable for other natural ecosystems. It has also been observed that the theory captures the imagination of researchers in relations to water and wetland management. The theory has been encouraged as the most justifiable theory to integrated divergent views of what constitutes sustainable use of wetlands and economic exploitation of the same. In conclusion, this theory is critical in relation to human activities and wetlands management based on the impression that water, biodiversity, and natural security necessitated sustainable exploitation of wetland resources that requires water diversity is related with a variety of interdisciplinary of factors to work as a group.

This theory is connected to the current study in that it addresses the current environmental conservation of wetland, a case of the Sondu River. This theory

postulates that efforts to conserve wetlands that have undergone degradation will require interdisciplinary and inter-sectorial coordination, which is essential for proper management (Roy, Jane, & Venema, 2011). Therefore, this theory is pertinent to this study when looking at the objectives.

## RESEARCH METHODOLOGY

### Sample Size and Sampling Procedures

The minimum sample size for residents was obtained using Slovin's formula. Using the formula, the sample was 144 respondents who were randomly selected where the study assumed that the chosen respondents were in one way or another engaged in human activities in wetland under study. The central theorem was used to select the sample population as shown in

*Table 1* below.

**Table 1: Distribution of the Sample Size**

Target group	Target Population	Sample
Environmental Officers (NEMA)	4	4
County government officers	10	10
Social facilities (schools and church)	20	20
Local leaders (Administrative and Political)	30	30
Business people (Sondu Market)	50	40
Community members	50	40
<b>Total</b>	<b>164</b>	<b>144</b>

## DISCUSSION OF RESEARCH FINDINGS

Out of a total of 144 questionnaires that were given out, 111 were filled and returned which comprised of six (6) cohort as provided in Table 2.

**Table 2: Distribution of Response Rate**

Cohort	Sample	Response	Achieved Return Rate
Environmental Officers (NEMA)	4	3	75.0%
County government officers	10	8	80.0%
Social facilities (schools and churches)	20	15	75.0%
Local leaders (Administrative and Political)	30	25	83.0%
Business people (Sondu Market)	40	30	75.0%
Community members	40	30	75.0%
<b>Total</b>	<b>144</b>	<b>111</b>	<b>77.0%</b>

Demographic information of respondents consisted of gender, age, education, occupation, locality, and occupation. The necessity of such information was to confirm whether the research reached the targeted audience and whether it captured the information which was being sought. The six provided the study analysis of the respondents' demographic evidence.

**Table 3: Respondents Demographic Information**

Demographic Information		Frequency	Percentage %
Gender	Male	67.0	60.0
	Female	44.0	40.0
	Total	111	100.0
Age	Less than 18	11.0	10.0
	18-35	22.0	20.0
	36-50	34.0	30.0
	>51	44.0	40.0
	Total	111	100.0
Highest Education Attained by Respondents	Primary	11.0	10.0
	Secondary	22.0	20.0
	Diploma	38.0	34.0
	Bachelor	29.0	26.0
	Others	11.0	10.0
	Total	111	100.0
Duration of Residency in Sondu Area and Locality	<than 1 Year	6.0	5.0
	1-5 Years	11.0	10.0
	6-10 Years	66.0	60.0
	10 Years	28.0	25.0
	Total	111	100.0
Occupation	Agriculture	67.0	60.0
	Business	11.0	10.0
	Civil Servants	22.0	20.0
	Others	11.0	10.0
	Total	111	100.0

The gender of respondents indicated that most of the study participants are of male gender accounting for 60.0% as opposed to females at 40.0%. Based on the magnitudes of male versus the female in the six (6) cohorts, the study recognized that the age dissemination of the respondents reached from less than 18 years to above 51 years of age. The majority (70.0%) of the respondents who contributed in the study were found to be aged between 36-50 years (30.0%) to those above 51 years (40.0%) while those in the minority were in the age bracket of below 18 years as well those of 18-35 years of age.

Many of the study applicants had attained education level of Diploma at (34.0%) followed by those who had attained Bachelor degree at (26.0%) and the

least were primary school leavers (10.0%). The findings show that the largest cross-section of respondents has the ability to comprehend concepts presented to them as respondents in the study.

It was found that the majority (85.0%) of respondents had been residents of the study area for 6-10 years, with the minority being resident for less than one year. The study found that most residents' occupation is in agriculture, accounting for 60.0%, followed by civil servants accounting (20.0%) such as Environmental officers (NEMA) and County government officers; the least number of participants were business people. The overall analysis of the data shows that the analysis utilized respondents who were qualified to provide well

informative information about the subjects of the study.

**Impact of Human Settlement Activities on Sondu River Basin**

The first objective of the study was to find out the effects of human settlements on the conservation of the Sondu River Basin. The most important activities engaged by respondents at the wetlands were found to be cultivation as accounted for by

38.3% of respondents, followed by grazing (25.0%), fishing (21.7%) and brick making (15.0%). It should be noted, however, that unreliability of rainfall (70%) was an important factor associated with the choice for wetland cultivation especially during dry seasons. Draining of water for ease of cultivation was done with the majority of the respondents digging trenches to drain excess water. The study found that those who cultivated either used chemicals or fertilizers on their fields (90%).

**Table 4: Activities Engaged at wetlands**

Activities Engaged at wetlands	Percentage	
Cultivation	38.3	
Grazing	25.0	
fishing	21.7	
Brick making	15.0	
Use of Fertilizers and Chemicals During Cultivation	Yes	90.0
	no	10.0
Reliability of rainfall	Reliable	10.0
	Unreliable	70.0
	Not Sure	20.0

The impacts of human activities on the wetland were analysed using a Likert scale of 1-5 as shown where 5=strongly agree, 4=agree, 3= undecided, 2=disagree and 1=strongly disagree. The outcomes have been partitioned grounded on the research questions.

**Table 5: Impact of Human Settlement Activities on the Sondu River Basin**

Statement	SA		A		U		D		SD	
	f	%	f	%	f	%	f	%	f	%
Human settlements posing threat to Sondu river conservation, if not well managed, they could lead to ills like environmental degradation.	27	24.0	29	26.0	22	20.0	11	10	22	20.0
Alteration effects Sondu river conservation, if not well managed, they could lead to ills like depletion of natural resources.	44	40.0	44	40.0	11	10	6	5	6	5.0
Human encroachment affects Sondu river conservation, if not well managed, they could lead to ills like physical destruction.	46	42.0	33	30.0	20	18.0	3	3	8	7.0
Human settlements patterns affect Sondu river conservation, if not well managed, they could lead to misuse of water resources.	33	30.0	33	30.0	22	20	11	10	11	10.0

The study sought to find out the influence of human settlements activities in Sondu River wetland Conservation; the majority of the respondents (68.0%) agreed that human settlements pose threat

to Sondu River conservation, which could lead to ills like environmental degradation, whereas 12.0% disagreed with this but 20.0% had no opinion on the same. The studies established that human

settlement is closely related to wetlands and riparian areas to the extent that the study has shown that a relationship exists between human and natural systems.

Concerning effects of alteration to Sondu River Conservation, most respondents (80.0%) either strongly agreed or agreed that indeed this issue leads to ills like depletion of natural resources and only 12.0% dissented with this assertion. On whether human settlements have led to adversities such as physical destruction, the study found that 72.0% of respondents either agreed or strongly agreed, 10.0% dissented, and 18.0% were undecided. Wetland degradation and loss are attributed to natural factor mainly, human activities, such as agriculture, industrial development, urbanization, pollution, and human settlements. Some studies have established that human activities have for a long time been associated with altering wetlands and riparian areas to a huge extent always done through activities such as irrigation, drainage, channelling and dumping of wastes through pollution (Romanowski, 2010).

Similarly, the study also found that most respondents (60.0%) strongly agreed with the assertion that human settlements pattern affects the Sondu river basin conservation and if not well managed, leads to misuse of water resources. Human settlements assume a lot of patterns, what is referred in other terms as morphology; this becomes a huge determinant of their accessibility and supply of services, integration of people and their utilization of resources at their disposal. Human settlements create a ready market for goods and services and hence making them beneficial to the economy. Despite human settlements posing economic opportunities, if not well managed, they could lead to ills like environmental degradation, depletion of natural resources, physical discomfort, and encroachment of wetlands.

## CONCLUSION AND RECOMMENDATION

The study sought to find out the influence of human settlements activities in Sondu Conservation, Majority of the respondents agreed that human settlements pose threat to Sondu River Conservation which could lead to ills like environmental degradation. Concerning the effects

of alteration to Sondu River Conservation, most respondents agreed that indeed this issue leads to depletion of natural resources. The findings in the study show that there is a strong inverse correlation between human settlement and conservation of the Sondu River Basin, which means that the more people settle and create habitats in the vicinity of Sondu River Basin the more the destruction of the basin increases.

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