INTRODUCTION OF AGRICULTURAL ACTIVITIES ON WETLANDS AND ITS INFLUENCE ON PHYSICAL ENVIRONMENT OF NAIROBI COUNTY

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ABSTRACT

Water is becoming increasingly important within Nairobi County due to the increasing population. This study assessed influence of agricultural activities in wetlands on the physical environment. Household questionnaire and Key Informant Interviews were administered on residents and County Government Environmental Agencies respectively. Data analysis involved descriptive inferential statistics. Majority of the respondents were males (55%); of ages 30-39 years (35%); with university degree (62%) ; married (43%) and most in business (37%). Farmers accounted for 21%. Human agricultural activities on wetlands influence the physical environment; causing soil erosion, loss of land cover, water and air pollution. Nairobi County thus requires harnessing the national policies to involve the community in education on the importance of wetland conservation; and also helping in cleaning the wetlands and planting trees upstream to conserve the riparian reserve. This will ensure satisfaction of human needs for both the current and future generations.

Key words: agricultural activities, wetland, physical environment, Nairobi County, Kenya

1.0 INTRODUCTION

Wetlands are essential in the well-being of humans in the context of socio-economic benefits hence their livelihood; and play a critical role in the environment such as water purification, water storage and water flow regulation, ecosystem balance through biodiversity preservation and conservation, carbon sequestration and water provision (Mwakubo *et al*. 2008). Adamus & Stockwell (1983) identified and documented the functions that wetlands perform for people: ground water recharge; ground water discharge; flood storage and desynchronization; shoreline anchoring and dissipation of erosive forces; sediment trapping; nutrient retention and removal; food chain support; habitat for fisheries; habitat for wildlife; active recreation; and passive recreation and heritage value. The importance of and threat to wetlands is manifested in the number of international instruments which govern their preservation and use (Mwakaje, 2009). The Ramsar Convention on Wetlands of 1971, the Rio-de-Janeiro Conference, the Kyoto Protocol of 1995 and the Copenhagen Climate Meeting of 2009 were results of the recognition that global and regional climate changes are a threat to the land resources on which human survival thrives (Rebelo, *et al.* 2009).

Kenya has insufficient water reserves: recyclable fresh water per capita as of now stands at 647 m^3 and is projected to tumble to 235 m^3 by 2025 if supply will not match up with the populace increment. This circumstance is ascribed to annihilation of catchment regions through decimation of forests, stream bank tilling and poor land utilization practices. The outcome has seen expanded run off, torrents, limited infiltration, soil wash offs and siltation of water reservoirs repositories (Saggerson, 1991). According to Allen and Debra (1990), as much as dangers differ amongst different areas and also within wetlands, agricultural practices are regarded as more critical. Partially, this is because of the extent of wetland agriculture that has witnessed an immense expansion in recent times and mucked up wetlands worldwide. However, the nature of most wetlands have undergone extensive and non-revesible transformations altered as people attempt to enhance agrarian profitability (Abila, 2005).

With the richness of the soils and moisture content, wetlands have become an easy fallback for land-hungry households and land speculators. Characterized by their shallow, reed lush laden vegetation and easy-to-drain briny water, they are being sapped for agricultural use at a distressing rate (Mwakaje, 2009). This is rapidly turning them into degraded dry lands and rendering them less productive, thus posing the twin hazards of famine and ecosystem obliteration. Filtering of nitrate from farming fields can hoist focuses in basic groundwater to levels unsatisfactory for consumption water quality (Crowards, 1996). Another downside to the expanding pesticide utilize is the improvement of resistance in vermin species. The individual vermin that survive pesticide applications keep on breeding, step by step delivering a populace with more prominent resistance to the chemicals connected (Rebelo *et al*, 2009). The purpose of this study was to assess the influence of agricultural activities in wetlands on the physical environment; while also looking at ways in which wetland utilization can be achieved sustainably.

2.0 RESEARCH METHODOLOGY

2.1 Research Design

This research adopted descriptive survey which was aimed at collecting both quantitative and qualitative data (Brink and Wood, 1998). In this study, the study configuration was utilized to explore the learning levels of the nearby inhabitants on how their activities influence the surrounding wetland resources; with a specific end goal to see whether absence of their insight thereof, might lead to this critical resource's degradation (Churchill, 1979). The research information was gathered in the normal setting and in a brief span, using questionnaires, interviews and/ or observation (Brink and Wood 1998).

2.2 Target Population

In this research, the populace of Westlands sub-county was 176,689 people according to the last Kenya National Bureau of Statistics 2009 census.

Table 1: Westlands Sub-County Population

No.	Name	Population (2009 National Census)	Area (Sq. Km)	Percentage Composition (%)
1	Kitisuru	31,202	21.30	17.7%
2	Parklands/ Highridge	38,344	8.20	21.7%
3	Karura	26,453	38.20	15.0%
4	Kangemi	44,564	1.60	25.2%
5	Mountain View	36,126	3.10	20.4%
Total		**176,689**		**100%**

In order to achieve the objectives of this study, the target population consisted of County Government agencies in charge of environmental conservation and wetland management.

2.3 Sample Size, Sampling Procedure and Instruments

2.3.1 Sample size

The minimum sample size n was obtained using the formula developed in Cochrane Handbook (2006) for populations that are large:

Where:

n = minimum sample size to be estimated

Z = critical value of the standard normal distribution for the 95% confidence interval around the true population (1.96)

P = Proportion in the target population estimated to have similar characteristic, in this case P is 89.4 % (in this case P is 89.4 % which is the estimated proportion of human activities that influence physical environment; study by Mirongo, 2005)

E=margin of error. Since the assumed proportion is 89.4, the allowable margin of error is 5

$$n = \frac{Z^2 P (100- P)}{E^2}$$

$$= \frac{1.96^2 * 89.4(100-89.4)}{5^2}$$

= 145.6 plus 10% of non response rate giving a total of **160** respondents.

This study adopted simple random sampling for household interviews. The sample selected was 28 respondents from Kitisuru, 35 respondents from Parklands/ Highridge, 24 respondents from Karura, 40 respondents from Kangemi and 33 respondents from Mountain View constituencies. This sample was based on the proportion of the population each constituency had (Table 1- Percentages Column). Purposive sampling was adopted in choosing Government Agencies for Key Informant interview (KII) which included 3 Environmental Officers from National Environmental Authority (NEMA) and 2 Physical Planners from Ministry of Devolution and Planning. An observation schedule was used to record agricultural activities, state of wetlands and changes in physical environment.

2.4 Pilot Study

A pilot study was done to test the validity and reliability of the research instruments. Split-half procedure of testing reliability was adopted and the value for Re was 0.85> 0.80 and hence the questionnaires developed were reliable (Joppe (2000). Triangulations were utilized to close the research inadequacies left by the data gathering tool and strategies. This was attained through desk surveys and personal questionnaires. Content legitimacy was resolved through subjecting the instruments through expert moderation, from the University of Nairobi.

2.5 Data Analysis

The questionnaire for data collection had the following main categories of information: bio data, social economic activities of the respondents, wetland management and utilization, changes within the wetlands and the physical environment. Threats to the wetlands, conservation and sustainable ways of their utilization also formed part of the data. Where necessary, non-parametric data collected was first standardized. Responses were standardized by using a standard scale of 1 to 5, where variables were numbered 1 = 5 scores, 2 = 4 scores, 3 = 3 scores, 4 = 2 scores, and 5 = 1 score. The gathered information condensed, coded, cleaned and tabulated. It was analysed using Statistical Package for Social Sciences (SPSS 20.0). In order to conduct inferential statistics, the study used multiple linear regression equations, and the method of estimation was by an Ordinary Least Squares (OLS) to develop a link between human activities and physical environment in Westlands sub-county. Correlation analysis and ANOVA was used to describe the degree to which one variable relates to the other. Data presentation was accomplished by the utilization of percentages and frequency tables.

Ethical considerations in this research involved the principle of wilful involvement. This was guaranteed through acquiring interviewee assent of the dangers and advantages of the exploration. Respondents understood that there would be no compensation obtained for giving information and the researcher respected and observed secrecy for each of the respondents through non-disclosure of characters and information from respondents to some different people.

3.0 RESULTS

3.1 Demographic Characteristics of the Respondents

The study sought to establish the demographic information in order to evaluate the influence of human agricultural activities on wetlands and its consequences on the physical environment in Nairobi County; a case of Westlands Sub-county. The demographic information comprised of gender, age, level of education, marital status and occupation.

3.2 Distribution of respondents by gender

The findings of the study as shown in table 2 indicate that majority of the respondents who participated in the study were male and accounted for 55%, while the female counterparts accounted for 45%. Males were more involved in the study because they did not shy away from being part of the study whose outcome would be used to salvage the wetland. This kind of disparity was not expected to bring any difference to the study as it was not the main area of concern by the research.

Table 2: Gender and Age (years) of respondents

Parameter	Category	Frequency	Percentage
Gender			
	Male	80	55
	Female	65	45
	Total	**145**	**100**
Age (years)			
	Under 18	7	5
	19-20	29	20
	30-39	51	35
	40-49	36	25
	>50	22	15
	Total	**145**	**100**

3.3 Distribution of respondents by age

The researcher sought to determine the age category of the respondents. The results as shown in table 2 above show that 5% of the respondents were under 18 years, 20% of the respondents were between the ages 19-29 years, 35% of the respondents were between the ages of 30-39 years while 25% of the respondents were between the ages of 40-49 years. 15% of the respondents were over 50 years. These discoveries uncover the mature respondents between 30-39 years were the majority. This proposes they could comprehend and recognize the issue at hand, which is wetland encroachment by agricultural activities and eventual degradation of the physical environment. It can also be observed from the findings of the study that most of the respondents who participated in this research are the youth as stated in the Kenya constitution, from age 18-39. This could be explained by the literate state of most young people who could read, understand and answer the questionnaires presented to them.

3.4 Distribution of respondents by level of education

The study also found it of importance to determine the participants' level of education which is crucial for this study as the respondents' level of education eliminates the bias of uneducated respondents.

Table 3: Education and Marital Status of Respondents

Parameter	Category	Frequency	Percentage
Education	Primary	0	0
	Secondary	7	5
	College	48	33
	University	90	62
	Total	**145**	**100**
Marital Status	Married	63	43
	Single	31	21
	Separated	37	26
	Widowed	14	10
	Total	**145**	**100**

According to table 3, the findings indicate that 62% of the participants were university degree holders, 33% of the participants had a college certification and 5% of the participants had only a secondary certification. Since many of the participants (62%) had university degrees, an assumption was made that a significant percentage of the participants had reasonable knowledge to execute the roles assigned to them effectively and efficiently, enabling them make prudent decisions.

3.5 Distribution of respondents by marital status

The marriage status of the participants was used to determine whether it positively and adversely impacted their demeanour and view towards wetlands conservation and management. The findings in table 3 reveal that 43% of the respondents were married, 21% of the participants were not married and 26% of the participants were separated while 10% of the participants were widowed. This indicates that many of the respondents were in a marriage relation and they were the individuals who were much likely to provide information on issues surrounding wetland degradation and management issues, as it would have impact on the physical environment and eventually on their families.

3.6 Distribution of respondents by occupation

The study sought information on the respondents' livelihood activities or economic occupation.

Table 4: Occupation of respondents

Parameter	Category	Frequency	Percentage
Occupation	Farmer	31	21
	Business	54	37
	Construction Worker	37	26
	Civil Servant	15	10
	Other	8	6
	Total	**145**	**100**

The findings in table 4 indicate that 21% of the respondents were farmers, 37% of the respondents were business men/women; 26% of the respondents were construction workers while 10% of the respondents were civil servants. Only 6% of the respondents on the other hand were not on the category of occupations mentioned. This shows that majority of the respondents understood the study being carried out and would in turn give adequate information on how human activities on wetlands influence the physical environment.

3.7 Agricultural Activities on Wetlands and the Physical Environment

The indicators of agricultural activities were deforestation to clear land for the farming practices, soil erosion and the use of agrochemicals.

3.7.1 Land reclamation, conversion of wetlands and loss of land cover

The respondents were asked their opinion on land reclamation causing loss of land cover; and the extent to which they agreed or not to this statement.

Table 5: Land reclamation and loss of land cover

Response	Frequency	Percentage
Strongly Agree	67	46
Agree	40	28
Neutral	20	14
Disagree	10	07
Strongly Disagree	08	05
Total	**145**	**100**

The findings in table 5 reveal that majority of the respondents, 46% strongly agreed to the fact that land reclamation and conversion of wetlands to agricultural land has led to rapid soil erosion and hence eventual loss of land cover in the area thus degrading the physical environment; and 28% agreed to the same. 14% of the respondents were neutral, which could mean that they did not fully understand the phenomenon under study; and 07% and 05% of the respondents disagreed and strongly disagreed to this statement respectively.

3.7.2 Agrochemicals and water pollution

The respondents were asked their opinion on whether use of agrochemicals resulted in water pollution; and the extent to which they agreed or not to this statement.

According to table 6, the findings reveal that majority of the respondents were of the opinion that agrochemicals such as pesticides and fertilizers are rampantly used by farmers in areas where they practice agricultural activities. This in turn has led to water pollution and thus wetland degradation. 58% strongly agreed to this statement and 31% agreed to the same. 07% of the respondents were neutral, 4% of the respondents dissented with this assertion; and 0% of the respondents unequivocally dissented with this assertion

Table 6: Agrochemicals and water pollution

Response	Frequency	Percentage
Strongly Agree	84	58
Agree	45	31
Neutral	10	7
Disagree	6	4
Strongly Disagree	0	0
Total	**145**	**100**

3.8 Agriculture and sustainable wetland utilization

The respondents were asked their opinion on whether there was a possibility of carrying out agricultural activities around the wetland area without inflicting damage to the wetland resources; and the extent to which they agreed or not to this statement.

Table 7: Agriculture and sustainable wetland utilization

Response	Frequency	Percentage
Strongly Agree	72	50
Agree	42	29
eutral	12	8
Disagree	10	7
Strongly Disagree	09	6
Total	**145**	**100**

The findings according to table 7 reveal that majority of the respondents, 50%, strongly agreed to sustainable utilization of wetlands for agricultural activities and 29% agreed to the same. 8% of the respondents were neutral, 7% of the respondents dissented with this assertion; and 06% of the respondents unequivocally dissented with this assertion. According to these findings, it was interpreted that most of the respondents were of the opinion that wetlands could be utilized sustainably for agricultural purposes without depleting the resource base. This is because population in the region has increased overtime, and the wetland is an important resource for their livelihood.

4.0 DISCUSSION

According to the findings of this study, the physical environment faces quite a number of challenges as a result of human agricultural activities on wetlands. The respondents reported that deforestation is one of these activities. As a result, soil erosion takes place after clearing of common vegetation and cultivation and drainage to transform wetland to farming land. According to Ashley, 2000, when common vegetation is cleared and farmland furrowed, the uncovered topsoil is frequently overwhelmed by wind or washed away by rain. Land reclamation and conversion of wetlands to agricultural land results to soil erosion, which influences productivity since it erodes the top soils containing the vast majority of the organic material, plant supplements, and fine soil particles, which hold water and supplements in the root zone where they are accessible to plants. As noted by Saggerson, 1991, the outcome of agricultural activities has seen expanded run off, torrents, limited infiltration, soil wash offs and siltation of water reservoirs repositories.

Wetlands can produce large amounts of food, but have substantial negative impacts on capital assets (Pretty, 1999). These assets comprise not only the natural resources of soil and water per se but also nutrient cycling and fixation, soil formation, biological control, carbon sequestration and pollination. The issue raises concerns about what constitutes success in agricultural production if large yield increases from wetlands come at the cost of environmental and health problems (FAO, 2001b). As noted by van der Warf, *et al.* 2002, some of the environmental issues that are related to agriculture are climate change, deforestation, genetic engineering, irrigation problems, pollutants, soil degradation, and waste.

Hance, Jeremy (2008), reported that trees act as a carbon sink: that is, they absorb carbon dioxide, an unwanted greenhouse gas, out of the atmosphere. When trees are removed from forests in wetlands, the soils tend to dry out because there is no longer shade, and there are not enough trees to assist in the water cycle by returning water vapor back to the environment. With no trees, landscapes that were once forests can potentially become barren deserts. The removal of trees also causes extreme fluctuations in temperature.

The use of fertilizers results in nutrients being lost from farming lands through overflow, waste, or connection to dissolved soil particles (Mwakaje, 2009). Crowards, (1996) reported that filtering of nitrate from farming fields can hoist focuses in basic groundwater to levels unsatisfactory for consumption water quality. According to Office of Environment Heritage. (retrieved on 12th April 2017), agriculture that practices tillage, fertilization, and pesticide application also releases ammonia, nitrate, phosphorus, and many other pesticides that affect air, water, and soil quality, as well as biodiversity

On the other hand, according to most respondents, another agricultural activity that influences the physical environment is the use of agrochemicals. These include herbicides for weed control, fertilizers, chemicals, for plant disease control and insecticides for controlling crop insect pests. The agrochemicals in turn affect physical environment by polluting water resources making it unfit for human and livestock consumption. Kidd, Greg (1999–2000) reported that synthetic pesticides such as 'Malathon, 'Rogor', 'Kelthane' and

'Confidor' are the most widespread method of controlling pests in agriculture. Pesticides can leach through the soil and enter the groundwater, as well as linger in food products and result in death in humans. Pesticides can also kill non-target plants, birds, fish and other wildlife. The pesticides may also kill beneficial insects there by upsetting ecological balance. Seufert, Verena *et al*. (2012) reported that organic farming is a multifaceted sustainable agriculture set of practices that can have a lower impact on the environment at the small scale. However in most cases organic farming results in lower yields in terms of production per unit area and per unit of irrigation water

5.0 CONCLUSIONS

In conclusion, agricultural activities on wetlands in Westlands sub-county have detrimental effects to the physical environment. This is due to the fact that farmers require to clear land for agricultural practices, and as a result of land reclamation, there is rapid soil erosion and loss of land cover. Another main factor is the use of agrochemicals which pollutes the ground water. However, due to the dire need of farmers to provide for their livelihood, wetlands could be used sustainably for agricultural purposes without depleting the resource base.

6.0 RECOMMENDATIONS OF THE STUDY

Paradoxically the livelihood activities account for the greater damage to the wetlands integrity. The remedies are to be found in the application of a coordinated enforcement of controlled use, participatory planning and management of the natural resources, exploration and promotion of alternative livelihoods, planting of wetland-friendly crops, and review of the policy on County Government extension support services to farmers. The Ministry of Environment should work together with the Ministry of Lands and the County Government to provide a secure land tenancy system; whereby the riparian areas should be clearly mapped and those living near this area should have legal title deeds. This will enhance conservation of the wetland. Regulation, protection, management and conservation of wetlands within public, private and community land are of essence.

The research also recommends the government should prioritize the implementation of policy and laws while integrating the community in the implementation process. The government may also designate the wetland as a Ramsar site in order to concentrate efforts to conserve it. Strategic litigation would also go a long way towards sensitization of the masses, enforcing the fundamental right enshrined in the Constitution on the right to a clean and healthy environment.

Community outreach and education program among the various stakeholders in order to enhance increased awareness and knowledge on the importance of wetlands and the impacts of agricultural activities on wetlands. NEMA and the various NGOs can sensitize local communities on wetland management since they are closer and can associate well with the local people.

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