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Livelihood Activities that Impact on Sustainable Wetland use in Upper Nzoia River Basin, Kenya

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Abstract

Worldwide, countries are facing pressure to meet the livelihood needs of their fast-increasing populations. This often leads to overuse of natural resources and consequent encroachment on fragile ecosystems such as wetlands. The deteriorating state of wetlands and consequent threats to sustainability of livelihoods remains a matter of concern to many governments, especially in developing countries. This study aimed to elucidate the effects of livelihood activities on wetlands. The study used a combination of cross-cultural and cross-sectional, longitudinal survey to elicit information and data. Purposive and non-purposive sampling strategies were applied. The following data collection instruments were used: survey questionnaires, key informant interviews, focus group discussions, observation checklists, community vulnerability assessments, maps from Survey of Kenya, digital camera, geographical positioning and reference equipment, satellite images, and literature in journals and government reports. Stakeholder participatory forums of focus group discussions, community vulnerability assessments and key informants were used to evaluate and rank impact mitigation options in wetland conservation. Results of the study showed that encroachment does not follow any fixed pattern but, rather, is driven by existing conditions of poverty, pursuit of livelihoods in the wetland. The study concludes that wetland encroachment and subsequent degradation is caused by land hunger due to fast rising population, and that participatory management and control measures are best suited to stem further deterioration of wetlands and entrench their conservation. The findings are of significance to policy and extension support institutions, as well as communities in wetlands. The results may also assist researchers and other stakeholders in the furtherance of knowledge on wetland conservation for sustainable development

Keywords: Wetlands, Livelihood Activities, Conservation, Sustainable

1. Introduction

Wetlands are among the most biologically productive ecosystems as they are rich in species diversity (Mwakaje, 2009). They perform various functions and services such as support to family livelihoods through crop production, grazing pastures and direct resource extraction. Ecologically they are vital for water storage, filtration, flood control and toxic retention.

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 Kyoto Protocol of 1995, the Rio-de-Janeiro Conference 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 depends (Rebelo, et al. 2009). They universalised the importance and scope to embrace all aspects of wetland conservation and "wise use" of the more than 1800 wetlands designated as internationally important (Lukas, 2006). As a signatory to these instruments, Kenya has progressively designated a number of lakes and sites as "Ramsar sites" (Ndaruga, 2009).

Despite their importance to settlement and agriculture, wetlands are threatened by the over-exploitation of the functions, products and services they contribute to livelihoods, and now they face intense pressure (Mwakaje, 2009). Kenya's Vision 2030 (MPND, 2008) restates the importance of agriculture as the mainstay of the economy.

The rapid population growth has led to widespread sub-division of original land parcels into agriculturally unviable holdings (Tegemeo, 2006). Owing to the richness of the soils and moisture content, wetlands have

become easy fall-back for land-hungry households and land speculators. Characterized by their shallow, reed-laden lush vegetation and easy-to-drain brackish water, they are being drained for agricultural use at an alarming 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 destruction. An all-stakeholder effort is needed to return wetlands to sustainable value.

The previously safe settlement schemes of the Upper Nzoia Basin which comprises Trans-Nzoia County in Western Kenya appear to bear the brunt of wetland destruction. The National Wetland Policy (MNRM, 2008) seeks to give effect to the importance of wetland conservation. With a population of 818,757 (KNBS, 2009), Trans-Nzoia County is famed for its grain-basket status and supports not only the larger Kenyan population but also, increasingly, the newly independent nation of South Sudan. Degradation of its wetlands has led to loss of wetland values. These have been aggravated by human population pressure, creeping poverty, and inadequate awareness on the importance of wetlands.

Despite international and national instruments instituted in recent times, there appears a widespread misconception that wetlands are wastelands and can therefore be converted to other uses such as agriculture, industrial development or residential. According to Dixon and Wood (2003), the misconception, especially among developing countries, is attributable to inappropriate government policies, socio-economic change and population pressure which exacerbate clamor for more agriculturally-productive land. Populations thus resort to untested land use practices which often neither protect the environment nor adequately meet their basic livelihood and food needs.

This paper examines the major livelihood activities and their impact on the conservation of wetlands in the Upper Nzoia River Basin of North-Western Kenya. A few mitigation measures are also suggested.

2. LITERATURE REVIEW

2.1 Drivers of Wetland Degradation

For many developing countries whose mainstay rely on agricultural and other land-based resources, population boom coupled with diminishing reliability of rainfall have resulted into expansion of livelihood activities into wetlands (UNCBD, 2010). In the Upper Nzoia river basin frequent flooding in the lower reaches of the basin is due to the deposition of large amounts of sediment and silt. These in turn decrease stream gradients due to the accumulated debris and siltation, and result in water flow obstructions, narrowed river channels and even backflow (Masibayi, 2011). Cultivation of wetlands is taken to present the best hope for the poor and landless to secure their food and livelihood needs in the short-run. This has been supported by some advocacy groups who argue that it is part of the legitimate pursuit for food security and, by extension, a human right (KLA, 2006). Indeed in Kenya, this right is entrenched in the Bill of Rights section of the new Constitution (GoK, 2010). This means therefore that to the extent that access to food is a human right, derivation of livelihood linked to food security is justifiable.

Many of the current conservation projects initiated in Kenya by institutions such as the West Kenya Community Driven Development (WKCDD, 2006), and the Kenya Forest Service's Natural Resource Management Project (KFS, 2007) emphasize the need to involve local populations and beneficiaries in any efforts to manage the natural resources. The projects' design emphasizes the importance of understanding customary and traditional approaches to conservation and integrating such approaches into more formal conservation strategies.

Fast population growth triggers land hunger which in turn drives livelihood search into fragile ecosystems. Tacconi et al., (2006) noted that at the sub-national level population density and deforestation are positively correlated. It is, therefore, unlikely that the current trend in wetland use will be reversed or even halted.

2.2 Wetland Resources Management

Through the human generations, the combination of water, light, and soil made wetlands an attractive habitat for a variety of animals, birds and plants which resources benefited the humans (Mwakaje, 2009). They were not normally cultivated and, in common with many African communities, wetland resources were communally managed under the indigenous authority exercised by traditional leaders on behalf of the community (Rebelo et al., 2009). The studies, conducted in Tanzania by Rebelo et al., (2009) show that under this practice, the social-political transformation has now vested authority for the management of natural resources in a range of formal government structures created to manage and regulate wetland utilization. However, given the measures in place, continued widespread encroachments in these countries is attributable to a combination of both the weakness in enforcement, and the inappropriateness of the measures.

In Kenya, The Report on Poverty and Land Allocation - also known as the Ndung'u Report (2004) - noted that under the colonial land/agriculture ordinances, wetlands were categorized under the Crown Land (also known as Unallocated Land) and were not normally cultivated. Thus at independence in 1963, they retained the status of unallocated land under Government control although they remained accessible to the public. This tight control largely helped protect wetlands for they were mainly used by the poor for collecting and watering activities which did not lead to much alteration of their natural and ecological state.

The Upper Nzoia basin sustains the livelihoods of approximately 3 million people in Kenya (GoK, 2001). Although the area constitutes a key part of what has been dubbed Kenya's grain basket, most inhabitants are subsistence farmers who are rapidly joining the ranks of the food insecure. Growing food insecurity is a product of low crop yields due to escalating costs of farm inputs and land degradation (GoK, 2005). Qualitatively, poverty in the region mainly manifests itself through hunger and malnutrition, which are attributable to dominance of maize as the staple food as against cassava, beans, millet, sorghum, potatoes and cabbages. The livelihood hazards are further crowned by deteriorating soil quality, crop monoculture, and fragmentation of land into unviable sizes, unreliable rains and high cost of credit (GoK, 2001).

Indeed the task force on hunger (Sanchez et.al. 2005) called for increase in the agricultural productivity of food insecure farmers; improvement in nutrition for the chronically hungry and vulnerable, and restoration and conservation of the natural resources essential for livelihoods and food security. It noted that the internal rapid population growth has resulted in a change in the pattern of land scarcity and population density, leading to intense encroachment into wetlands. According to this report, there is a clear trend of increasing numbers of households that own less than two acres, with a correspondingly smaller portion under cultivation. On average, evidence shows that the non-poor cultivate smaller plots of land than the poor do, and a good number in both categories do not cultivate any at all. The implication of this is that cultivating land doesn't necessarily increase the chances of avoiding poverty but, rather, that these strata of society who make their living from land, i.e. various types of agriculturists, are more prone to poverty than those groups who find other sources of income.

It is also noteworthy that, despite the introduction of the post-independence program to resettle the landless Kenyans in some of the former white settler farms, wetlands remained uncultivated. The Upper Nzoia Basin and its surrounding areas with similar ecological characteristics formed an important part of these programs popularly known as the settlement schemes (ML&S, 1974). Years of repeated cultivation has led to severe soil erosion, over-drainage, soil exhaustion and consequent falling yields, the combination of which has led to intense pressure on wetlands.

2.3 Legislative Framework and Policy for Resource Management

The Legislative and Policy framework for resource management in Kenya portrays a more preservationist and law enforcement approach to natural resource conservation. The major ones include: the Agriculture Act (Cap 318), the Environment Management and Coordination Act (EMCA) of 1999, the Water Reforms Act (2002), the Wildlife Conservation and Management Act (1997), the Forest Act (2005), Fisheries Act (1991) and the Mining Code (1980), all of which are published by the Government Printer, (GoK). Other documents include the Kenya Vision 2030 (2007) and the National Wetland Policy (2008), both of which are published by the Government Printer, Nairobi. The wetland policy provides for, among others, government's collaboration with stakeholders to map wetland areas countrywide and encourage, promote, and support the development and implementation of catchment-based wetland management plans through a participatory process. It manifests Government's desire to customize key Ramsar guidelines, while Kenya's Vision 2030 (Section 5.4) addresses environmental issues and explicitly spells out the government's objectives in environmental conservation as per Goal 7 of the Millennium Development Goals (GoK,1999).

In spirit, these legislations mostly provide for either sectoral or functional approach to the management of wetlands. However, the conflicts between and among them can be attributed to weaknesses in the existing sectors, agencies and institutions established to implement and enforce the laws and policies under the respective statutes. Indeed, these weaknesses are amplified in Chapter 3 of the National Land Policy (2007) as:

i. Ineffective Government regulation of private property rights, as a result of which unplanned settlements and environmental degradation have become commonplace

ii. Development control is exercised by various Government agencies whose activities are uncoordinated with the result that the attendant regulatory framework is largely ineffective, e.g. wetlands, road reserves, and hills

iii. The individualization of land rights has undermined indigenous culture and conservation systems, and

destroyed traditional resource management institutions such as in wetlands

iv. Recognition of benefit sharing from land-based natural resources as "...a concept that has gained popularity in Kenya and globally" and by which communities and individuals are increasingly becoming aware of their rights to own and use natural resources within their environs, as well as participate in the conservation and management of such resources (Section 3.3.4.1).

The National Land Policy and the contemplated supporting legislative provisions constitute the instruments that will be applied to control the widespread encroachment on wetlands in Kenya. Besides, the new devolved system of Government gives Counties considerable responsibility over local resources and is bound to motivate communities into collaborative arrangements with authorities (GoK, 2010). It seems appropriate therefore that in the face of the post-colonial paradigm of land tenureship, Government adopts a participatory approach whereby local people are encouraged to take more responsibility for their natural resources on a sustainable basis. Their success may depend to a significant extent on the duality of traditional-cum-legalistic practice. In addition, it is bound to vary with the diversity of livelihood opportunities available to the communities as well as revenue sources accessed by the County Governments.

Realization of the full benefits is bound to take a little while to come. The devolved and contemplated responsibilities under the devolved system of government in the new Constitution include the development of social infrastructure, payment of local officials, and the management of local resources. The question of whether decentralization and localization of development and service delivery will improve matters will depend on factors such as governance, resource management skills, local politics and ethics. This may owe to the fact that as long as land takes high precedence in wealth ranking in Kenya, wetlands will remain vulnerable to population and livelihood pressures for many years to come.

2.4 Mitigation Measures for Wetland Degradation

Cultivation of wetlands contributes significantly to rural livelihoods in terms of both direct cash income and food security (Rebelo, 2009). It is therefore unlikely that further development of wetlands for agriculture can be prevented when viable alternative livelihood opportunities are lacking.

The current shift towards a paradigm of community-based conservation is based on a strong economic dilemma faced by forest-adjacent communities. They face severe livelihood constraints including wide scale poverty, land pressure and lack of development opportunities which renders them highly dependent on forest resources for both income and subsistence (Emerton, 1999). The study cites the case of Mount Kenya where government policing and protection of large and inaccessible conservation areas is rendered ineffective by the inadequacy of resources.

The calls for participation of local communities thus demonstrate the necessity to achieve realistic conservation. Indeed the recurrent controversies over many of Kenya's water towers succinctly demonstrate the desirability and importance of balancing conservation interests with local demands for settlement and livelihoods as exemplified in the creation of the Mau Forest Secretariat in 2009 to tackle issues of encroachment. The preference for home-grown sustainable environmental management may involve a certain extent of deforestation as an acceptable trade-off for forest conservation (Tacconi, 2006).

The Water Act (GoK, 2002) introduced reforms that provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services and for related purposes. Complementary to the reforms, the Water Resources Management Authority (WRMA), established under Section 7 of the Water Act is vested with the regulation and management of water resources. WRMA may designate catchment areas, defined as areas from which rainwater flows into a water course, each of which shall develop a catchment area management strategy (Section 14 of the Act).

The Forest Act (GoK, 2005) and the eventual creation of the Kenya Forest Service (KFS) has helped to focus attention on consolidated approach to management and utilization of all types of forests in Kenya. The Forest Act (KFS, 2005) confirmed the important role forests play in the stabilization of soils and ground water and hence support to sustainable agriculture. It emphasizes community participation in forest management and the application of impact assessments as provided for under EMCA to control major changes in land use.

From the legislative and policy enunciations, it is clear that Kenya has a well defined desire to address a range of environmental and socio-economic issues in the larger Lake Victoria basin, of which Mt. Elgon and Cherengany Hills in the Upper Nzoia Basin are a part.

To make operational the provisions of the National Wetlands Policy (2008), an elaborate set of regulations

dubbed The Environmental Management and Co-ordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2008, were formulated by the then Ministry of Environment and Mineral Resources (MEMR). Agriculture constitutes the most important source of livelihoods and food security of the population in the region, and relies on the environment to deliver on these functions.

The interplay between and among the variables in wetland use and conservation is shown in the conceptual framework (Figure 1) below.

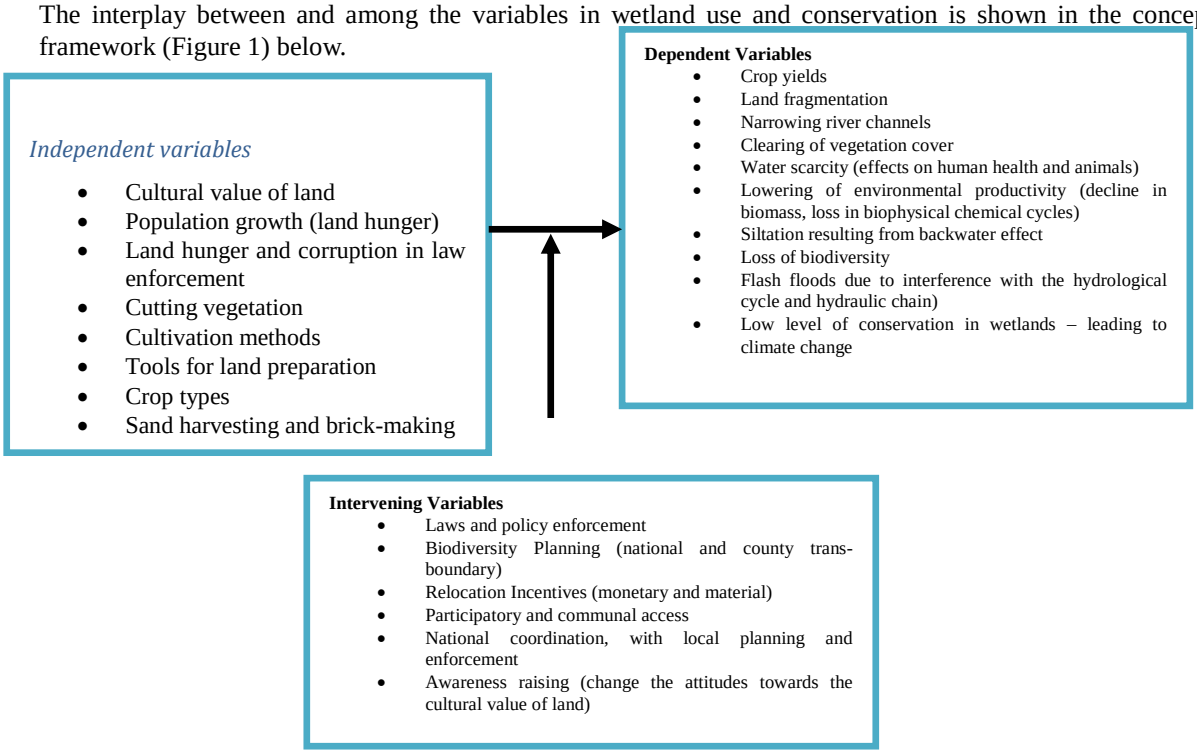

Figure 1: Conceptual Framework for the interaction of variables in wetland conservation**.** Source: *(Author, 2012).*

Measures of intervention to mitigate the trends in wetland degradation are the concern of local, national and global efforts which are manifested in various planning Workshops, Conferences and Treaties respectively. In Kenya, they are seen in the institutional structures and policy measures that have been instituted in recent years. The intervening variables include law and policy enforcement in wetland conservation, biodiversity planning and advice on proper types of trees to grow, and mass awareness programs. In countries where conservation seems to conflict with basic needs such as food, the thrust of the discussion seems to point to the importance of understanding customary and traditional approaches to conservation and integrating such approaches into more formal conservation strategies.

The search for appropriate interventions in wetland conservation in Kenya should derive from a close look at the cause-effect variables identified through stakeholder surveys. Those independent variables such as population growth, land tenure practices, and feeble institutional structures are the main cause of changes in the biophysical integrity of wetlands.

3. METHODOLOGY

The study used a combination of survey, cross-cultural, and evaluation research designs (Table 1). The survey design permitted an examination of the land tenure systems, the types and tools of land tillage, crop types and vegetation cover, the extent of anthropogenic developments, and of bio-physical changes. The cross-cultural design was used to examine the various livelihoods activities impacting on the integrity of the wetland environment. The evaluation design permitted an examination of the range of mitigation options available in sustainable wetland utilization.

Table 1: Objectives, variables and research design adopted in the study

Specific Objective	Variables	Research Design
Examine livelihood activities that impact on the conservation of wetlands	Farming activities Socio-economic activities Expenditure patterns Cultural practices	Survey and Cross-cultural
To evaluate intervention options for sustainable wetland use and conservation	Statutory control Participatory management Institutional changes Alternative livelihoods	Evaluation

The research designs addressed the fact that the study area has, over the last 40 plus years, undergone land use transformation from dominant large scale grain and dairy farming to medium to small scale mixed farming. In the process, wetlands have come under increasing cultivation from land–seekers and business people from different ethnic, cultural and economic backgrounds in Kenya. Besides the different approaches to land use and livelihood pursuits have impacted on the integrity of wetlands.

The research involved interviews with 23 key informants comprising the following representation: 4 experienced partners each representing land owners, small-scale, medium and large scale; 7 Officers each representing a key Department of Government in the study area, namely Lands, Agriculture, Water, Health, Administration, Livestock, and Education; 7 Officers each representing key Parastatal Organisation in the study area, namely KWS, NEMA, NCPB, WRMA, KFS, AFC and CRS; 2 NGO/CBO Officials each representing World Vision and Vi-Agro Forest; and 3 Traders involved in the supply of agro-vet farm inputs and in the buying of farm produce such as maize. The purposive selection of key informants aimed at drawing representation from business, the farming community, policy and institutions in the farming and environmental conservation fields within and outside the study area. The information gathered covered the key socio-economic parameters and the overall livelihood characteristics of the communities, as well as specific land use practices.

Proportionate stratified random sampling was used in selecting wetlands on the basis of category, i.e. riverine, tributary and inland; and in selecting strata of wetlands use, i.e. small, medium and large, and finally of households. In addition, quota sampling was used in selecting participants in the individual wetland FGDs and CVAs. Quota sampling was also used in selecting vulnerable individuals in households to discuss community-wide vulnerability issues.

Table 2: Primary Data collection organization and data collection instruments for study population units

Study Population Units	Sampling Method	Sample Size	Data Collection Instruments
Service Providers NGOs Dev. Partners	purposive	23	Interviews
Land Owners/ Farmers	Stratified random	378	Questionnaires
Local Opinion Leaders Public members	Quota	20	Interview
FGD Members	Quota	80	FGD
CVA Members	Quota	60	CVA
Various for checklist	Purposive	16	Observation checklists

3.1 Research Findings

Socio-economic Characteristics and resultant Biophysical Changes

The baseline survey provided a variety of information on the human socio-economic and demographic characteristics. Results obtained present the variables which were considered important in determining the extent and methods of land use, and the resultant changes in the biophysical characteristics of the encroached wetlands.

Gender of Household Head

The distribution of the gender of household heads across the 8 wetlands is displayed in Figure 2.

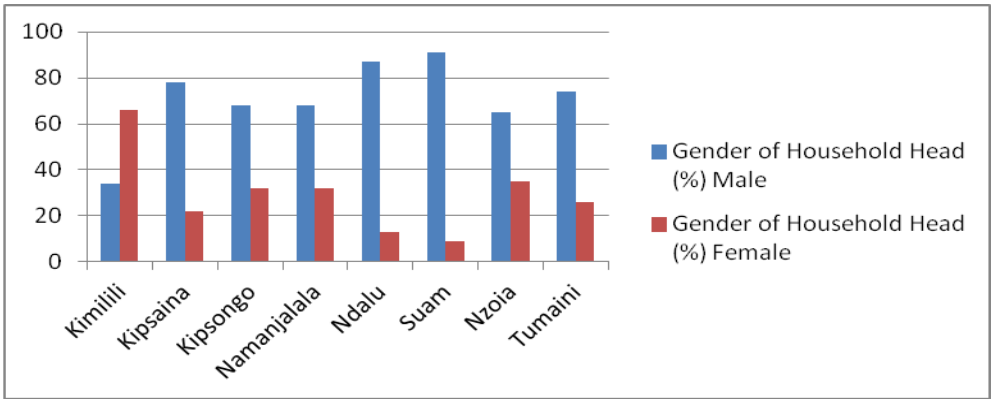

Figure 2: Distribution of the Gender of Household heads in the study area

The Chi-square test of the gender of household head against the wetland had a highly significant (P<0.01) variation where 27, 0.01= 48.5322. Most of the sampled wetlands showed a male domination in household headship. The exception was that considerable female headship was in Kimilili while Suam had the lowest. The incidence of female dominated headship in Kimilili may be partially attributed to the fact of it being a traditional and homogeneous clan settlement. In Kipsongo, a similar high tendency (at above 30%) may be attributed to the fact of it being squatter settlement where family displacements and poverty occupy a key place in assigning roles. Females take a heavier responsibility in heading households and pursuing livelihoods in contrast to the more cosmopolitan settlement scheme households of Kipsaina, Namanjalala, Suam and Ndalu where men bear greater responsibility. This is authenticated by the fact that out of the 47 households surveyed in Kimilili wetland, 31 households representing 66% were headed by women. On the other hand, on average 75% of households in the other seven wetlands surveyed were male-headed. It is noteworthy that three wetlands (Kimilili, Kipsongo and Namanjala) are geographically more peri-urban than the others – namely Kipsaina, Ndalu, Suam, Tumaini and Nzoia – which are located in typically rural settlement scheme zones where medium to large scale farming is practiced. In the latter category, wetlands show less variation in livelihood pursuits as men dominate headship of households and land tenureship as depicted in Figure 4

Age Distribution

The Pearson's Chi Square value (p) for Wetland versus Age of Household head was 228, 0.01= 52.309, which portrays highly significant (p<0.01) dependence between the two variables. The distribution of age groups across all wetlands varied substantially with the wetland. Therefore, there is high certainty that a member of the sample population selected at random from a particular wetland represented that particular age group in that wetland only but could not be similar to the others of same age group in the other wetlands.

Age is a factor in wetland utilization to the extent that it affects household headships as well as land tenureship. As discussed above regarding land tenureship, the decision on livelihood pursuits is normally by the head of household. Figure 4.2 shows clearly the distribution bias for age bracket 34-50 years, which from the observation checklists, the key informant interviews as well as FGD and CVA forums confirm the age bracket that displays highest concern for family responsibility and for which provision of household livelihood is generally a priority. Besides, as noted in the studies by Tegemeo (2004), farming is a major source of employment for those in the employment brackets; hence the tendency for age brackets 18-33 and 34-50 to dominate the age distribution in wetlands. The implications of this are that wetland encroachment is as closely tied to the pursuit of employment as it is to that of livelihoods. This finding confirms that of the study in South Africa by King (2006), that conservation has various impacts and meanings, within a specific community, that are tied to the livelihood and governance systems. Thus, the younger residents are less likely to participate in managing conservation programs but rather show greater interest in employment-creating activities in the wetlands.

The age distribution of household heads by wetland is shown in Figure 3 below:

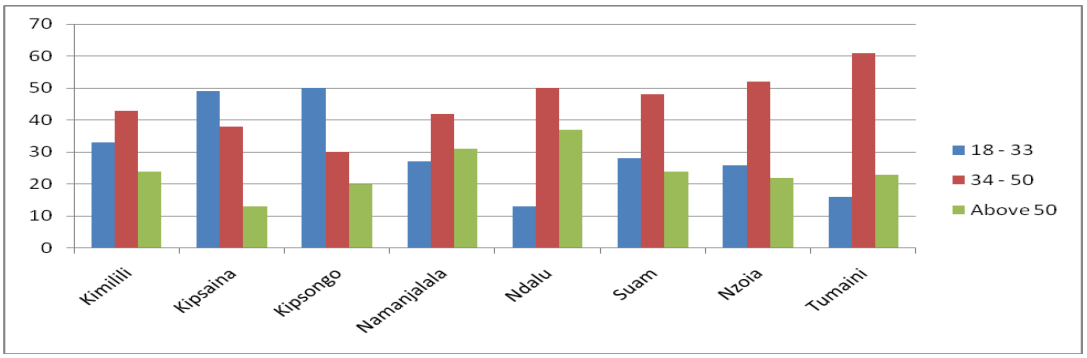

Figure 3: Age distribution of Household heads across the Wetlands in Upper Nzoia River basin, Kenya

Religious Affiliations of Household members

The distribution of religious affiliations of respondents (in percentage) by Wetland is shown in Figure 4.

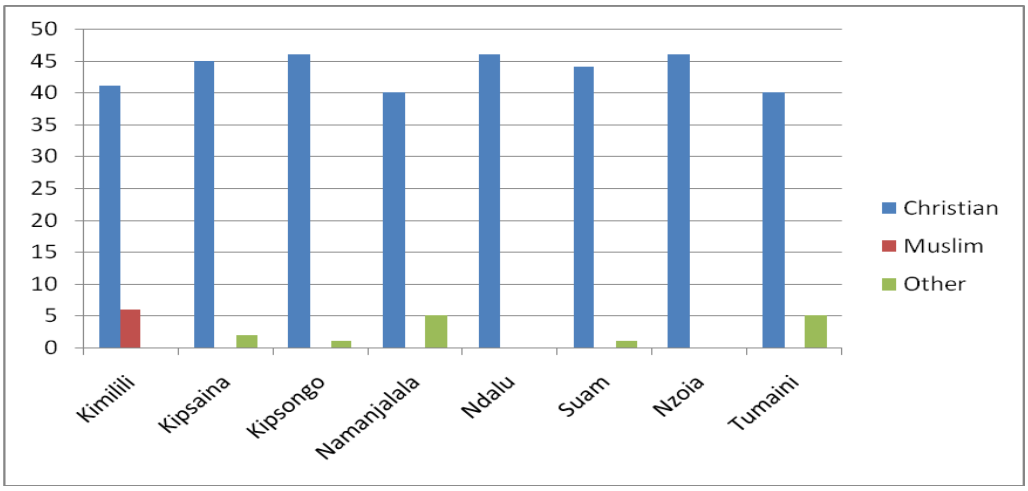

Figure 4: Distribution of Religion of Respondents in Upper Nzoia River Basin, Kenya

During the research, an assumption was made that religious and other cultural traits might have an effect on the population's use and practices in wetland conservation. Chi square test analysis, however, reveals that religious affiliations versus wetlands are highly significantly ($P<0.01$) associated (221, 0.01= 65.560). Results in Figure 4.3 show that all wetlands studied appear dominated by Christianity-affiliated religious faiths, yet this does not present any peculiarities in trends of encroachment or use. Thus communities are driven by factors other than religion and tradition. These also agree with the results of King (2006) which showed that wetland use by communities remain tied to the reigning livelihood and governance systems more than any other consideration.

Education Level of Household head

The percentage distribution of education levels by wetland is shown in Figure 5.

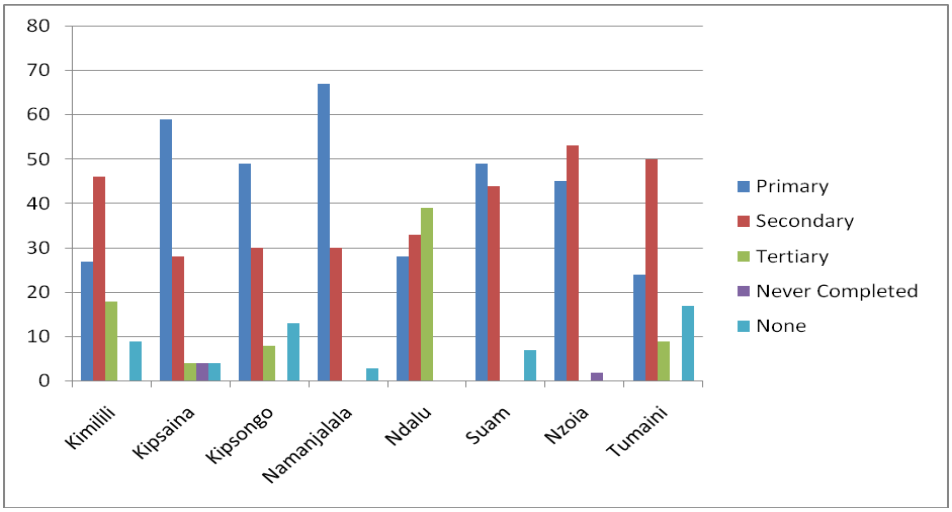

Figure 5: Distributions of Education Levels of Household Heads in Upper Nzoia River Basin, Kenya

Chi Square test indicates that there are highly significant differences (P<0.01, 228, 0.01= 112.618) in the educational levels of household heads across all wetland sites.

Education does not seem to play any significant role in the choice and use of wetland resources by the population that has encroached on them. The FGD and CVA rankings (Table 4.3) showed little association between education and wetland encroachments. Similar results were noted in interviews with key informants and observation checklists made during the study. The overall results confirmed the findings by Hulme & Murphree (2001) which concluded that more than any other factors, wetland use by communities remain tied to the reigning livelihood and governance systems. The implication of these findings is that, to the communities, livelihood needs take precedence over knowledge and education about the environmental implications of wetland encroachment.

Marital Status

The distribution of respondents' marital status is shown in Figure 6.

The Chi-square test gave 235, 0.01= 97.505 portraying a highly significant (P<0.01) dependence between marital status of household head and wetland.

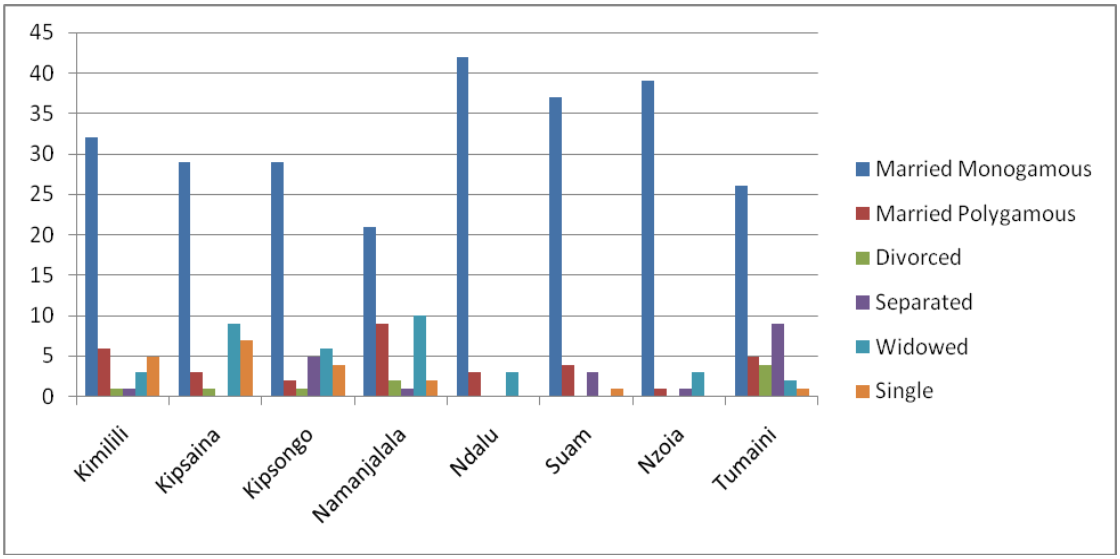

Figure 6: Distribution of Marital Status by Wetland in Upper Nzoia River Basin, Western Kenya

Marital status directly affects the household size and hence the intensity of livelihood pursuits and, by extension, the need for additional land. As shown in the discussion on age distribution, age brackets 34-50 tend to dominate the wetlands population, implying that this is the population that is mostly in need of additional livelihood opportunities. This may be explained by the fact that extended cultivation of wetlands is linked to polygamous families and or young families looking for livelihood opportunities outside the parental holdings which are getting outstripped by the fast-increasing population and unemployment.

Households Size

The distribution of house hold size across the 8 wetlands is shown in Figure 7.

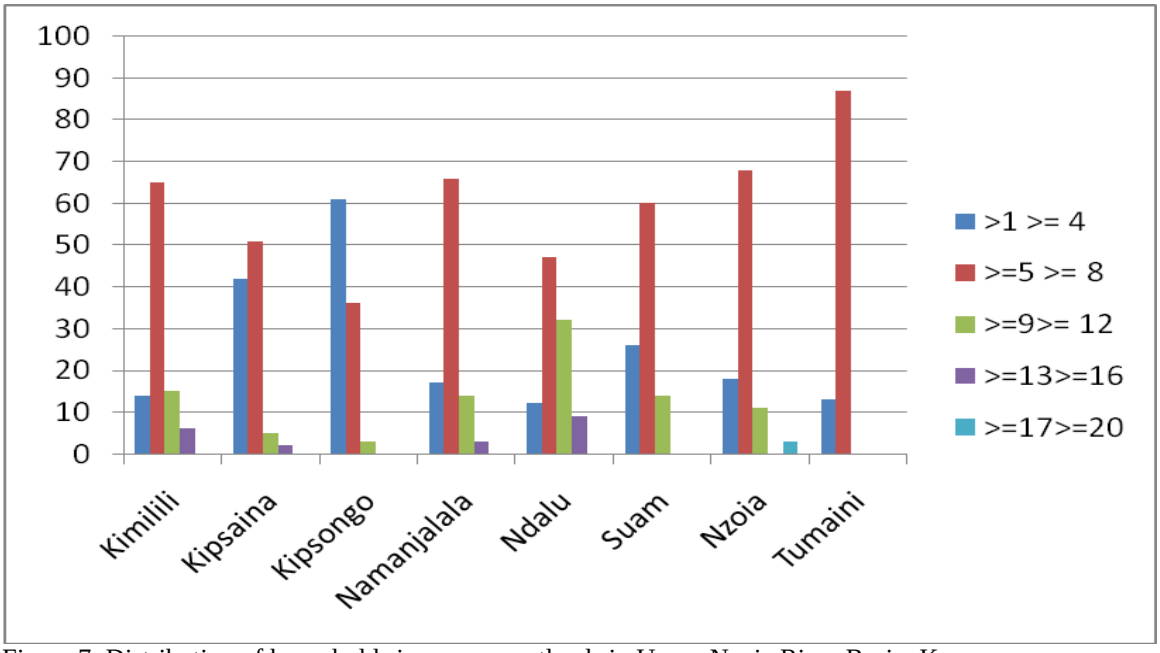

Figure 7: Distribution of household size across wetlands in Upper Nzoia River Basin, Kenya

The Chi-square test shows a highly significant difference (p<0.01, 228, 0.01= 97.888) in household size across all wetland sites. Household sizes showed a marked variation. However, the study showed a greater alignment towards an average rural household size of the range 5-8.

It can be inferred from Figure 4.6 above that the population is high across the wetlands. Household size has a bearing on the diversity of livelihood activities engaged by the members, some of whom depend on the wetlands' resources. This is in line with the studies by Mwakaje (2009) and Maconachie & Binns (2006), in which risk distribution was cited as one of the features of wetland utilization. Similarly, observation checklists, FGD and CVA forum discussions revealed that household members engage in multiple livelihood such as crop cultivation, charcoal burning, brick making, sand harvesting and fishing in order to argument income. The inference here is that availability of alternative livelihood opportunities would ease the pressure on wetlands and hopefully result in a corresponding easing of pressure on wetland resources.

Type of Shelter owned by Household

The distribution of the type of shelter owned by households is depicted graphically in Figure 8.

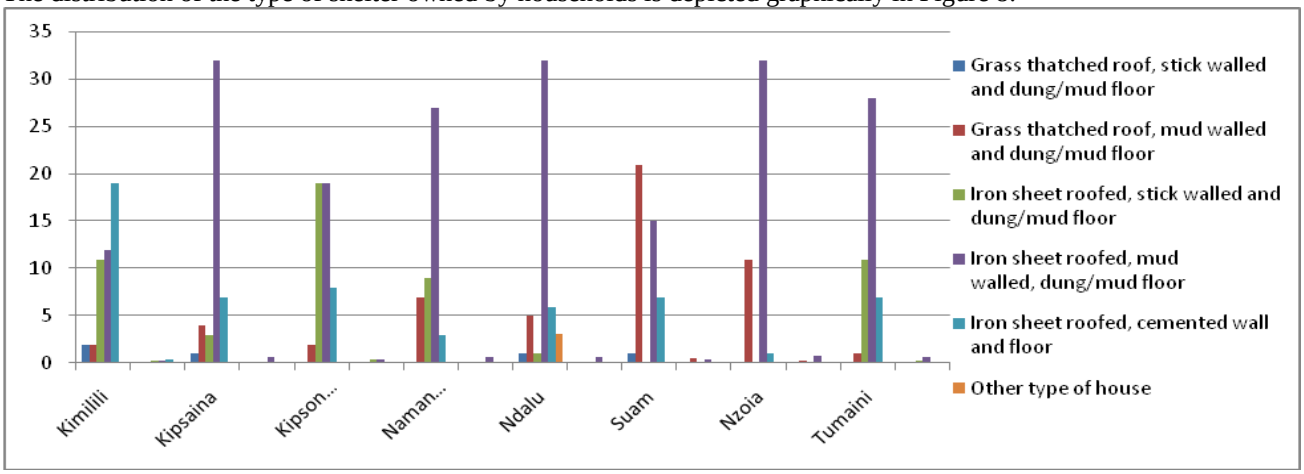

Figure 8: Distribution of Type of Shelter owned by Household in Upper Nzoia River Basin, Kenya

The Chi-square test with 235, 0.01= 169.582 indicated a highly significant (P<0.01) dependence between the type of household shelter and wetland.

Shelter, although one of the basic human needs as ranked in Maslow's hierarchy of needs, is considered as occupying a lower position than say, food. In the pursuit of livelihoods in the wetland therefore, the type of shelter a household lives in reflects its level of satisfaction with the other needs. The results depicted in Figure 4.7 show that improved shelter in the categories that have are iron-roofed and mud-walled dwelling units hold a higher percentage than those built of grass-thatched roofs and mud floors and those with iron-roofs and cemented walls and floors.

Studies conducted in rural Tanzania (Mwakaje (2006), depict rural communities as generally poor and focusing on livelihoods that meet life's basic needs. As is the case in Kenya, competition in basic needs would place shelter in lower rank to food and, therefore, the major drive in wetland encroachment is more of food-based than shelter. This is true even if, as observed in the results on crops yields and sales, food security does not derive directly from stored food harvests but rather from purchases from livelihood income as revealed by the distribution of monthly expenditure on food by wetland (Figure 4.24). The implication from these results, which are supported by inferences from the FGD and CVA data, is that improvement in type of shelter owned by wetland respondents is a reflection of the surplus income after households have met higher rank needs.

A further implication of the generally poor quality of shelters in wetland settlements is that it also corroborates the fear of eviction or relocation expressed during the CVA forums, in which wetland settlements are regarded as generally temporary and therefore not meriting investment in what may be regarded as expensive dwelling shelters.

Cultivation as a Major Activity

The distribution of responses on cultivation as a major is shown in Figure 4.8.

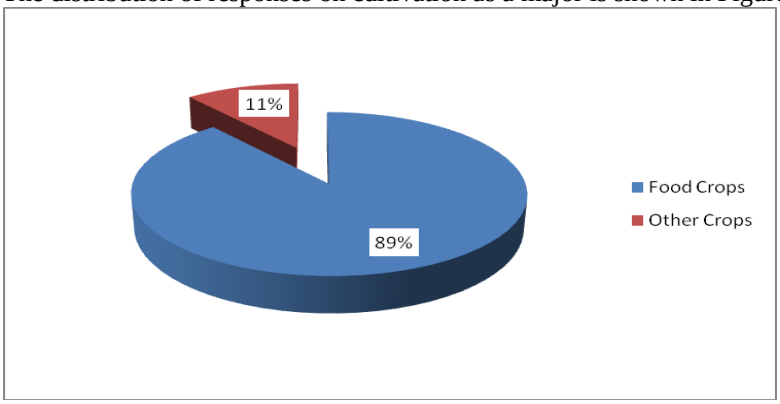

Figure 9: Distribution of responses on cultivation as major activity in Upper Nzoia River Basin, Kenya

The Chi-square test with $\chi^2_{5,\ 0.05}$= 10.35 indicated non-significant (P>0.05) dependence between cultivation as a major activity and wetland. Thus there were more similarities with regard to cultivation among wetlands.

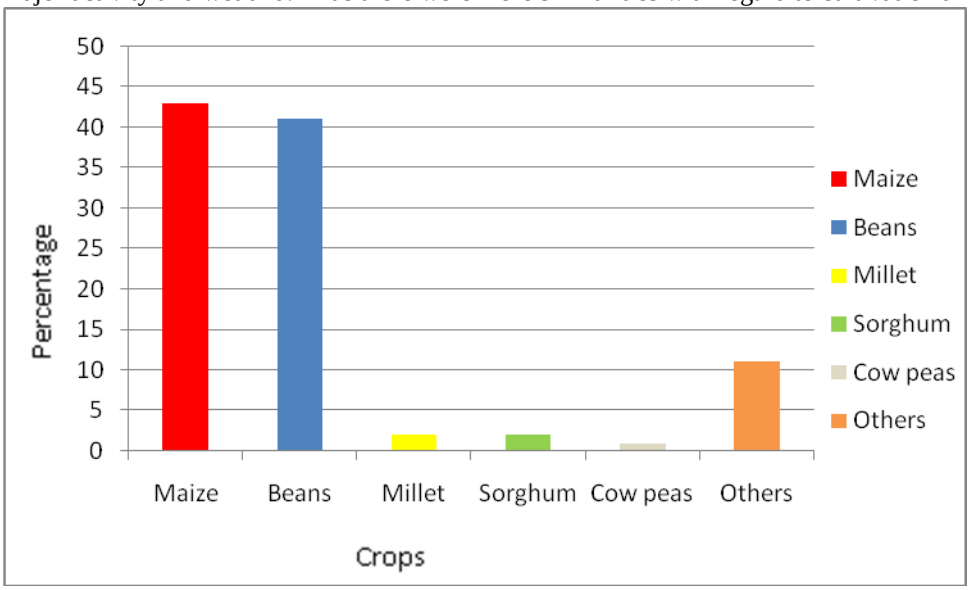

Figure 10: Crop Frequency of Cultivation as a Major Livelihood Activity in Upper Nzoia River Basin, Kenya

The ranking of livelihood sources by both quantitative and qualitative data sources put farming (particularly food crops) at the top of livelihood sources (Figures 4.8). Land cultivation for food crops in the wetlands is, therefore, a major livelihood activity. Other crops grown include sugar cane and market oriented horticultural products such as tomatoes and onions as shown in Figures 4.8 and 4.9. Data on crop yields and sales show that most cultivation is undertaken for income source and not for food security alone. This inference corroborates the findings of the study undertaken by Tegemeo (2004), and also by the Ndung'u Report (2004), that farming – and by implication owning a piece of land – is a major source of employment which, in Kenya, is pursued by any means as a source of livelihood.

Distribution of Plot Sizes across Wetlands

The percentage distribution of plot sizes across the wetlands is shown in Table 3.

Table 3: Percentage distribution of plot sizes across wetlands in Upper Nzoia River Basin, Kenya

Wetland	< 0.5 acre	0.5 - 1 acre	1 - 2 acres	2 - 3 acres	Above 3 acres	None
Kimilili	2	13	16	16	53	0
Kipsaina	8	19	49	10	8	6
Kipsongo	0	9	4	0	0	87
Namanjalala	13	50	23	2	6	6
Ndalu	2	17	31	25	25	0
Suam	0	31	20	31	18	0
Nzoia	18	46	18	4	7	7
Tumaini	34	13	25	22	6	0

A Chi Square test of $\chi^2_{35,0.01} = 897.62$ indicates a highly significant ($p<0.01$) dependence between wetlands and plot sizes. Across the study area, plot sizes in encroached wetlands vary from 0.5 to 5 acres. The rise in the number of plots and cultivated river banks is attributed to the parceling of land holdings to accommodate secondary settlers who either bought or inherited land from the pioneer settlers. This observation by the respondents confirmed the remarks made in the Ndung'u Report (2004), which called for enforcement of the necessary legal provisions to protect wetlands and other fragile resources like water catchment towers.

The overwhelming preference for the enforcement of conservation policy provisions was demonstrated during the FGD and CVA discussions and subsequent ranking of mitigation options. This is confirmed by the satellite images which reveal that during the early years of the land settlement scheme program, wetlands remained largely intact under the first generation settlers. According to the residents, human encroachment on wetlands took a steep rise during the 1980s, with cultivation extending to less than one meter of the river banks. This practice became common with the advent of the second and subsequent generations of settlers comprising the new land buyers as well as those who acquired the land through the traditional inheritance from their relatives or original owners.

Biophysical changes in the Wetlands

The most visible changes in the wetlands studied are to be seen in the physical characteristics. In this study, three variables were chosen as the main indicators for gauging the changes, namely: changes in the river channel profile, land/vegetation clearing, and the encroachment by human activities. The changes were tracked through satellite imagery spanning a period of 40 years (1970-2011). Ground truthing was undertaken from observations made on the ground through transect walks, participatory observations, and focus group discussions.

Changes in the biophysical characteristics of the wetlands are the outcome of activities that tend to overuse the soils, vegetation, and water resources.

Table 4: Areal wetland changes in 1973, 1986, 2011

	1973	1986		2011	
Location	Area (ha)	Area (ha)	% Change	Area (ha)	% Change
Tumaini dam	3.7	2	46	1	50
Kimilili	92	54	41.3	15	72
Ndalu	114	39	65.9	0	100
Namanjalala	3,668	1,105	69.9	230	79.2
Nzoia	247.78	74.79	69.8	52.19	30.2
Suam	137.887	92.55	32.9	79.73	13.9
Kipsongo swamp	18.68	9.78	47.7	7.84	10.4
Kipsaina	171.43	75.02	56.2	55.33	26.2

Source: (Author)

The largest drop in wetland area between 1986 and 2011 were observed at Kimilili, Namanjalala and Ndalu. Kimilili lost 72% of its wetland, Namanjalala lost 79.2 and the worst case was observed at Ndalu which by 2011

had lost its entire wetland (100%). Wetland losses are not a recent phenomenon but were also noted in the GIS data of the period between 1973 and 1986. For instance the highest losses between 1973 and 1986 were observed at Ndalu and Namanjalala which dropped by 69.8% and 69.9% respectively.

4. Discussion of the Results

Distribution of plot sizes across wetlands in the Upper Nzoia River Basin revealed a clear trend of increasing numbers of households that own less than two acres, with a correspondingly smaller portion under cultivation. In addition, the results of the survey of the yield of major crops grown show a falling trend in productivity, implying growing risk of serious poverty in the area.

These results agree with the report on poverty made by Ndung'u (2004) in which evidence showed that on average, the non-poor cultivate smaller plots of land than the poor do, and a good number in both categories do not cultivate any at all. Thus, the implication is that cultivating land does not necessarily increase the chances of avoiding poverty but, rather, that these strata of society whose livelihoods depend on land are more prone to poverty than those groups who find other sources of income. Hence, the rankings of impact mitigation options in wetland conservation favored finding alternative livelihood sources among the priority action measures.

Land use practices in wetlands show similarities to the practice of mixed farming and the poor distribution of non-farm earnings in rural areas characterize the small-holder farms in the settlement farms in Upper Nzoia River Basin. According to Ndung'u (2004), these give rise to the common perception among peasant communities that extending cultivated land will increase crop production and therefore assure stable livelihoods and food security. However, in his view, this assumption is not necessarily true because the non-poor cultivate smaller plots of land than the poor do, and do not depend on cultivation only as they do have other sources of livelihood. Given that on average the non-poor hold less land than the poor, it can only be inferred that their productivity is considerably higher than that of the poor. According to the report, this is to be explained by better access to credit, irrigation and fertilizers. It seems, therefore, that it is this category of the non-poor landless that has the propensity to look for alternative and additional sources of income, including potent ones such as wetlands and forests, to augment and maintain their relatively higher income.

Results of the study and observations by the researcher showed that farmers in the study area grow maize and beans mainly as cash crops. They seek to exploit the continuous availability of water to maximize production and thus earn quick and frequent income through sale of green maize. The probable loss to farmers is substantial because the maize is not sold at its maximum value and does not get to household stores for food security. This finding corroborates that by Tegemeo Institute (Tegemeo, 2004) which found that the poor and small-scale farmers go into maize and beans production as items to sell. According to Tegemeo (2004), the seasonality of maize also distorts its food security value and, because it allows multiple channels of disposal, makes maize production and movement difficult to track.

The sellable importance of maize and beans and their role as the local food staple in wetlands results in their preponderance over other crops and, unwittingly, exacerbates the incidence poverty and food insecurity at household level. The implication of this is that the combination of poverty and hunger, which are products of high population growth against the slow growth or non-availability of matching resources, is a major driver of environmental degradation. This revelation is not new. A government report (WMS, 1997) showed that land hunger had led to escalation in encroachments on wetlands in search of livelihoods and threatened to irreversibly alter the biophysical characteristics of the ecosystem. There is therefore a need to not only gauge the extent of the damage, but to also devise mitigation options that will permit sustainable livelihoods while preserving the environmental integrity of wetlands in the Upper Nzoia River Basin.

The findings of this research largely corroborate those (King, 2006) studies which found that communities do not take certain actions based on some common factor. They cannot therefore be understood in generic or homogeneous context as this has little or no influence on how they respond to extension information packages, especially if the messages conflict with their livelihood interests. This study set out to evaluate mitigation options that could be applied to wetlands conservation while permitting sustainable livelihoods. In the Upper Nzoia river basin, there is real threat of an imbalance between conservation of wetlands and livelihood needs. This situation is now common in all the five water towers in Kenya, i.e. Mt. Kenya, the Aberdares Mountains, Mt. Elgon, Cherengany Hills, and Mau Forest where community resistance to relocation frequently occupies political debate. In these fragile ecosystems the people have found new livelihood opportunities and will not let go of them. The results of this study also confirm similar studies by King (2006) in the Mahushe Game Reserve

in South Africa which found that conservation had various impacts and meanings within a specific community that remained tied to the livelihood and governance systems that replaced the apartheid era. This finding has important implications for efforts directed to address the issues surrounding encroachment on Kenya's fragile ecosystems and livelihood pursuits.

5. Conclusions and Recommendations

Within the inevitability of wetland cultivation, this Paper concludes that land-use activities account for the most important source of livelihoods in the wetlands. This has resulted in the depletion of tree and other vegetation cover, enhanced cultivation and anthropogenic and other human socio-economic activities. 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 Government extension support services to farmers.

Within the assumptions, limitations and the methodological approaches taken by this study, it is deemed desirable that the structure and function of the ecosystem mechanisms should be decentralized to wetland or catchment level by expanding the role and capacity of the Water Resource Users' Associations (WRUAs) under the Water Act, 2002, to spearhead the establishment and implementation of an incentive scheme for planting wetland-friendly crops and trees by the wetland users.

There is need for a concerted multi-sectoral and multi-agency approach to promote participatory conservation by exposing user communities to other alternative livelihood sources and land use methods such as application of agri-business in order to optimize use of small plot sizes within the context of wetland conservation. In line with the NEMA mandate for enforcement of environmental laws and regulations, there is need to develop a comprehensive national policy and appropriate institutional structure through the formation of a National Wetland Authority (NWA).Working within an appropriate institutional framework, it should have the mandate to develop suitable spatial wetland management plans and provide policy guidance and technical back-up to Counties in their resource management function.

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