

**The importance of Nyando river wetlands plant resources and agricultural
products:
A comparative study of papyrus and rice**

BY

Omollow, Maurice Omondi
(B.A. Hons, Moi University)

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master of philosophy in environmental planning and management**

**SCHOOL OF ENVIRONMENTAL STUDIES,
MOI UNIVERSITY, P.O. BOX 3900
ELDORET, KENYA.**

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DECLARATION

DECLARATION BY THE CANDIDATE:

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Signed 20th February, 2003.

Maurice Omondi Omollo

SES/PGM/08/99

SUPERVISORS

Dr. Okeyo-Owuor, J.B

Division of Environmental Biological Sciences

School of Environmental Studies

Moi University, Kenya.

Dr. Paul Omondi

Department of Geography

School of Social, Cultural and Development Studies

Moi University, Kenya.

ABSTRACT

This study assessed the community perceptions of the importance of wetland plants, particularly papyrus (*Cyperus papyrus*) and compared it with that of agricultural products, mainly rice (*Oryza Sativa*), in the Nyando River Wetlands, Kenya. The goal was to suggest better mechanisms for the sustainable management of the two resources and the wetlands. It was conducted among communities living in NRW area namely Nyando, Lower Nyakach and Kadibo Divisions of Kisumu and Nyando districts, from August 2000 to February 2001. Primary data was gathered using field observation, interviews, group discussions and questionnaires, administered to 120 randomly selected household heads. Secondary data was collected from published and unpublished materials. Results were analyzed using descriptive statistics.

The community perceived papyrus to be important as a source of income, building material and production of handicrafts. Rice was viewed as a major source of family income and food. Majority, 65 (54.2%) respondents perceived rice to be more important, compared to 47 (39.2%) who perceived papyrus to be more important and 8 (6.7 %) who were undecided. This difference was significant ($\chi^2 = 42.5$, $p = 0.05$, $df=2$). There was no significant relationship between demographic factors and respondents choice of product with more value. However, there was a significant relationship between respondents' choice and the physical characteristics of the wetland site in their locality ($\chi^2 = 10.76$, $p = 0.05$, $df=4$). The mean monthly income from rice was Ksh. 3106 and Ksh. 2414 from papyrus mat making. The differences in monthly mean incomes from the two enterprises were insignificant [F. (6, 79) = 0.651, P= 0.05].

The study concluded that both papyrus and rice were important for the socio-economic development of the community. However, unchecked harvesting of papyrus, fire outbreaks, poor farm management practices, lack of appropriate skills, limited financial resources, poorly developed infrastructure, marketing problems and land use and land ownership conflicts resulted in the mismanagement and degradation of the wetlands. To increase community incomes and strengthen wetland conservation, there is need to identify and promote sustainable uses of the wetlands based on community perceptions of the importance of the wetlands, raise their awareness of the importance of wetlands conservation by providing appropriate training, education, extension services, financial and technical assistance. The wetlands should be zoned for various land uses, community based organizations established and strengthened, co-ordination between stakeholders in wetlands use and management enhanced and a comprehensive wetland management policy developed. There is need to investigate the uses of other wetland resources, demonstrate their wise use, plan for their conservation and explore the possibilities of making Nyando River Wetlands a Ramsar Site.

Key words: Community, Importance, Wise Use and Perception

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LIST OF ACRONYMS

CBOs	Community Based Organizations
EPM	Environmental Planning and Management
G.O.K	Government of Kenya
Ha	Hectare
IUCN	World Conservation Union
Ksh.	Kenya shillings
KWS	Kenya Wildlife Service
LBDA	Lake Basin Development Authority
LVEMP	Lake Victoria Environmental Management Programme
NGOs	Non Governmental Organizations
NIB	National Irrigation Board
NRW	Nyando River Wetlands
NWCP	Nyando Wetlands Conservation Programme
UNCHS	United Nations Centre for Human Settlements (Habitat)
UNEP	United Nations Environmental Programme
WCED	World Conference on Environment and Development
WRI	World Resource Institute
WWF	World Wide Fund for Nature

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CHAPTER ONE: INTRODUCTION

1.1 Statement of the problem

In Kenya, there is mounting pressure to reclaim and convert certain major wetlands including NRW, to agricultural use thus negating the need for their conservation. Many believe that Kenya needs food more than “idle” natural swamps and therefore the reclamation of these wetlands and conversion into agricultural units seems legitimate and justified (Mavuti, 1992). Therefore, in spite of the ecological and economic value of the NRW, current trends in their exploitation may lead to their destruction unless wise use principles are developed and applied.

The NRW are encroached and degraded through poor land use practices, improper management and unsustainable use of its resources by overgrazing, over cropping, over fishing, over harvesting of wetland vegetation, wildlife-human conflict and invasion by the water hyacinth (Okeyo and Raburu, 1999). Lake Victoria wetlands are increasingly being replaced by cash and food crops such as rice, which is perceived to give high yields and give immediate economic returns and therefore more important. The acreage under crop and agricultural production has increased steadily in the lake region over the years (GOK, 1995). Lack of concerted efforts to conserve natural plant resources in this fragile wetland ecosystem is a major environmental problem.

Several methods have emerged to assist in wetland valuation (Turner and Jones, 1991). Despite their variability, wetland benefits are usually very significant, no matter how they are measured. Therefore, whichever management strategy adopted, it is important that wetlands are correctly valued and their importance documented (ibid.). Thus the importance of natural wetland plants and agricultural products should be investigated so as provide data important for conservation and for improving the rural economy. While carrying such investigation, a special account must be taken in relation to demography, income distribution and vulnerability of certain groups such as women, children and the old (WRI, 1992 and UNEP, 1992)

Wetlands habitats should be conserved in order to ensure the maintenance of representative species, ensure population viability, maintain the ecological and evolutionary process and ensure development (Woodley, 1993). One approach to conservation is to maintain healthy populations of species that play a critical role in the ecosystem. When such is conserved, the whole ecosystem is conserved in the

process. This was the rationale behind the selection for research and conservation of papyrus, a keystone species in the NRW

1.2 Justification and significance of the study

Wetlands along Nyando River constitute an important resource base that can be utilized for the benefit of the local people. The resource has a potential for increased production of improved diversity of products in the handicraft industry. It thus can contribute to improvement of the socio-economic status of the local community. However, the current uses of the wetlands and its biological resources are not sustainable and will lead to their destruction unless remedial measures are taken. Unchecked harvesting of wetland products will lead to a number of socio-economic and environmental problems in the area. Of great concern is the imminent loss of employment especially for the people who depend on the wetlands as a source of income. For example, papyrus is used to produce mats, furniture and baskets, which are sold both at the local and international markets. However, this plant is being overexploited, destroyed by fire and in some parts of the wetlands, communities are replacing it with crops such as rice.

Encroachment of the wetlands by agricultural production has led to the reduction in the wetland area and reduction in wetland plants, human-wildlife conflicts such as the destruction of crops by wildlife, reduction in grazing areas and introduction of pollutants into the waters. The complex dynamics and significance of wetlands and its attendant agro-based problems needed to be investigated for them to be well understood. Traditional wetland research (with a bias towards scientific aspects) have tended to ignore the scenario of conflicts in resource uses and the desire to integrate socio-economic values as well as the need for conservation.

There was need to obtain data to enhance wise use practices and sustainable farming in the fragile wetland ecosystem. It was necessary to compare the perceived benefits of papyrus and rice in order to establish community needs for conservation and development. The findings were expected to yield information needed for the development of a sustainable planning and management strategy for the wetland. This may be replicated in other areas with characteristics similar to the study area. Data on comparative benefits or importance of papyrus and rice in NRW was scarcely known prior to this study. The comparative study was expected to yield information important for determining the most sustainable way in which the wetlands can be

used, improved, assist in decision making and strengthen community awareness and training. The study was a significant component to the NWCP and for academic purposes

1.3 Study objectives

The overall objective of this study was to assess the perceived importance, values and uses of papyrus, a common wetland product and compare it with that of rice, the most common agricultural crop grown in the wetlands along the Nyando River, Kenya. The aim was to generate relevant data that would be used to suggest appropriate management approaches for the two resources and the wetlands.

Specific objectives:

- i. To assess the perceived importance, uses and values of papyrus as a major wetland resource to the community.
- ii. To evaluate the perceived importance, uses and values of rice as major agricultural crop to the community.
- iii. To compare the perceived importance of the two resources.
- iv. To suggest appropriate planning and management strategies for the wetlands based on wise use of papyrus and sustainable rice growing in the area.

1.4 Research questions

The study was pursued within the framework of the following research questions.

- i. What are the important uses of papyrus to the community?
- ii. What are the important uses of rice to the community?
- iii. How does the production of rice conflict with the growth of papyrus in NRW?
- iv. What are the community perceptions of the importance of papyrus compared to that of rice?
- v. What are the opportunities for planning and managing the NRW based on the wise use of papyrus and sustainable rice growing in the area?

1.5 Study hypothesis

- i. That rice, an agricultural product is perceived to be more important than papyrus a natural wetland plant product, and therefore favoured by majority of the NRW residents.
- ii. That there is a significant relationship between community perceptions of the product with more value and respondents age, sex, level of education, income and the physical characteristics of their locality.

1.6 Scope of the study.

The study was limited to the communities in the lower parts of Nyando River Basin bordering the Winam Gulf of Lake Victoria. It was based in the three administrative divisions that border the wetlands namely, Kadibo in Kisumu District, and Nyando and Lower Nyakach in Nyando district.

The study area covered parts of the administrative boundaries of five locations found in the three divisions namely East Kochieng' and Kanyagwal in Kadibo division, Kakola in Nyando division and Rangul and Nyalunya in Lower Nyakach division.

This study focused on NRW community development based on the sustainable use of wetland resources. It borrowed greatly from the Wise Use of Wetlands (RCB, 2001) and Environmental Planning and Management concepts (Eagles 1984., UNEP/UNCHS 1987). The main focus was to study the community perceptions of the social, cultural, economic and environmental importance of the wetland products in order to come up with a sustainable utilization plan. It aimed at establishing the uses of wetland resources as raw materials for market products, the socio-cultural importance of the wetlands and the local wetlands management practices. Estimates and assumptions were based on the monetary value of the wetland and agricultural products at the time of data collection. This study did not include the in depth study of the biological functions and structure of the wetlands. However, some inquiries were made to establish existence of such knowledge amongst the respondents. Research questions were mainly on direct uses or values of the wetland products.

A common plant, papyrus was selected as a natural product in the wetland and its importance established both quantitatively and qualitatively as compared to rice, a major cash crop grown in and around the wetlands. Papyrus was considered in this study as the flagship or keystone species to represent natural wetland plant resources. In this case, its conservation or degradation could be used as an indicator of the state of the wetland ecosystem especially the natural plants community. Similarly, rice was chosen as representative of the major agricultural crop production systems or alternative use of the wetlands. Success or failure in rice production would then give an insight into agricultural performance in the wetlands. Generalizations were made based on the local understanding and knowledge about the uses of the wetland resources being studied.

1.7 Definition of operational terms

Agricultural production: Refers to cultivation of land in the NRW to produce consumer products. In this study, the focus was on rice as an agricultural product.

Baraza: A baraza is a council of local elders in a village headed by the chief, discussing development issues in the location as well as solving local disputes.

Community: People living in the NRW area who have a common interests as far as the use and management of the NRW is concerned.

District: A geographical area which is a constituent administrative unit of a province, headed by a District Commissioner

Ecosystem: A self-regulating community of plants and animals interacting with one another and with their non-living environment (Odum, 1993). The wetland ecosystem refers to the plants, animals and their non-living components.

Environmental management: A conscious, systematic effort to produce an aesthetically pleasing, economically viable and physically healthy environment (UNEP/UNCHS 1987)

Importance: The significance, use or value of something. In this study, it was used to refer to the positive uses, values or attributes of the NRW to the community.

Location: A geographical area which is a constituent administrative unit of a district, headed by a Chief.

Perception: The ability to see, hear or understand something or a phenomena. In this study, the way respondents saw or understood values provided by the NRW.

Planning: Is a rational process of arriving at decisions and implementing them. It involves a conscious effort to increase the validity of environmental policies.

Stakeholders: Bearers of separate interests. In this study, it included the community members, conservation groups, government and Non-Governmental Organizations.

Wetlands plant products: Plants growing naturally in the wetlands. The focus in this study was on Papyrus (*Cyperus papyrus*)

Valuation: The estimation of worth of a good or service

Value: The worth, utility or equivalent estimate of something or the benefit a good has for humankind. It has to do with giving or holding in respect or as dear.

1.8 Organization of the thesis

The thesis is organized into six chapters. Chapter one, the introduction, presents the background to the study, statement of the problem, justification, study objectives, hypotheses, scope and the study area. Chapter two analyses related literature and the conceptual framework. Chapter three presents the research methodology, methods of data collection, analysis and presentation. Chapter four presents the study results while chapter five presents the discussion of the results. Chapter six presents the study conclusions and recommendations.

1.9 THE STUDY AREA

1.9.1. Location and extent

1.9.2 Climate

1.9.3 Geology, relief and drainage

1.9.4 Natural vegetation

1.9.5 Population

1.9.6 Socio-economic activities

Table 1.2: Population and household distribution in selected sub-locations bordering NRW in 2000.

Division	Location	Sub- location (s)	Total population	Household number
Nyando	Kanyagwal	Ogenya and Bwanda	1500	195
	Kakola	Kakola Ombaka	2440	197
Lower Nyakach	Rangul	Kasae and Jimo- middle	1918	180
	Nyalunya	West –Kabotho	6464	285
Kadibo	E. Kochieng'	Okana	7225	395
			19547	1252

Source: GOK, 2001

The study area is dominated by small-scale, subsistence agriculture with increasing market participation, together with some large-scale sugarcane and rice plantations. Small-holdings average 2.5 hectares. The major cash crops include rice, maize and sugarcane. Other cereals include maize and sorghum. Paddy is produced in most of the Nyando, Kadibo, Muhoroni, Miwani and the Lower Nyakach divisions. Pulses include beans, green grams, cowpeas and groundnuts.

Agricultural production is low and cannot meet the food demand in the area. Therefore, most of the foods are imported from neighbouring districts. Agricultural production especially that of rice has been fluctuating mainly because of uneven rainfall patterns, excessive flooding, financial constraints and management problems (G.O.K 2001).

Livestock in the area includes cattle, goats, sheep, pigs, poultry, rabbits and bees. Livestock have traditional and socio-economic importance for the people although incomes from their trade are low. Most of the livestock are grazed in the wetlands and this sometimes results in their degradation.

1.9.7 General land uses and cover types

1.9.8 Transport and industrial infrastructure

1.9.9 Institutional framework

1.9.5 Constraints to resource use, conservation and management.

2.8 Synthesis of literature reviewed and conceptual framework

From the literature review, it is clear that wetlands are important ecosystems that are under great threat from several human activities. The main reason for wetland destruction especially in the tropics has been driven by the desire to satisfy human needs such as food, which is perceived to have more direct benefits than conserving them in their natural state. There is lack of detailed research on the socio-economic and environmental values they provide to local communities. Several international and local efforts have been initiated to reverse the trend. The acquisition of reliable data on wetlands socio-economic values would therefore greatly assist in the development of appropriate policies for their conservation.

Because wetlands are undervalued, they are continuously being degraded. This study attempted to explore the various socio-economic and environmental importance of the NRW, which could provide an insight into their use and misuse. The study

premise was developed from the understanding that wetlands are common resources liable to degradation as explained by the theory of “Tragedy of the Commons” (Hardin Garret 1968 in Ostrom, 1990), while their planning would best be achieved by the promotion of “Wise Use” (RCB 2001) and the application of the theory of “Environmental Planning and Management”(Eagles, 1984).

Thus the central theme of this study was to investigate and provide a comparative analysis between wetland products, and alternative uses such as rice farming and in the importance of their conservation. This was achieved by comparing the uses of wetland plant resources, in this case papyrus, and that of agricultural crop, rice, and showing cause for their planning and conservation. The information obtained is presented in this thesis and provides the basis and justification for planning for the conservation of the Nyando River Wetlands.

3.3 Description of the study sites

Site A

Wetlands in Site A traversed Nyando and Kadibo divisions. Kakola location in Nyando division and Kanyagwal location while in Kadibo division were selected. Kakola Location has several wetland namely Singida Beach, Swaywe, Nyangweso, Mikombe, Oketha, Alara, Nyatini, Arombo, Nyabondo, Siany and Giko which lie along tributaries and distributaries of Nyando river. The researcher interviewed households around Singida Beach in Kakola location on the Shores of Lake Victoria.

The natural wetlands in Kanyagwal Location include Ogenya, Nyagugu, Owere, Ambowo, Ugwe and Odega. The researcher interviewed households living around Ogenya beach.

Site B

Wetlands in Site B traversed Rang'ul and Nyalunya locations in Lower Nyakach division. In this site, reference was made to households in the Wasare and Komwaga wetland areas. Wetlands in Rang'ul location included Wasare, Kamichiri, Kasao, Ochuoga, Miruka and Masai. In this location, respondents living in the wetland area around Wasare were interviewed. The wetlands in this sub-location are on both sides of Nyando River. The western portion is not settled and is usually seasonally flooded. The greatest impact or encroachment on the wetland is mostly around Wasare rice irrigation schemes. In this place, papyrus is cut to be replaced with rice and horticulture farms.

In Nyalunya Location, wetland users around Komwaga wetlands were interviewed. In this site, the wetland was heavily encroached by human activities, to the extent that there was little or no buffer zone left along the lake shore and river bank. The beach along the lake was covered by water hyacinth making the local communities to abandon fishing and turn to encroachment of wetland resources.

Site C

Site C consisted of the wetlands found in Kochieng' East location of Kadibo Division namely Okana and Mbega, wetlands. Okana swamp was chosen as the study site in this area. It was chosen for comparison of perceptions with those from the two sites above. In this site natural wetland plants had been depleted and the people were

forced to travel over a long distance in order to get papyrus for the production of market products.

It was assumed that the views and perceptions of the respondents in this site would differ especially in relation to their perceptions of the importance of wetland resources compared to agricultural production. A summary description of the study sites is given in table 3.1

Table 3.1: Summary description of study sites

Site (strata)	Administrative Locations covered	Sub- location (s) covered by wetland area	Major wetland	Description of the wetland
A	Kanyagwal	Ogenya and Bwanda	Ogenya	Lacustrine, borders lake at river mouth
	Kakola	Kakola Ombaka	Singida	Lacustrine, borders lake at river mouth
B	Rangul	Kasae, Jimo-middle	Wasare	Lacustrine, borders lake at river mouth
	Nyalunya	West –Kabotho	Komwaga	Lacustrine, borders lake at river mouth
C	East Kochieng'	Okana	Okana	Is found in the Kano swamp (upper part of the basin)

3.4 Data sources and collection methods

Both primary and secondary data were used for the study. Primary data was collected using questionnaires, interviews, observations and focus group discussions. Photographs were used to record some observations. Secondary sources of data included published, unpublished materials, topographical and cadastral maps.

CHAPTER FOUR:

RESULTS AND DATA ANALYSIS

4.0 Introduction

This chapter presents the results obtained from the study. It is organized into six sections. Section 4.1 outlines the general population characteristics and knowledge of wetlands conservation, section 4.2 the perceived importance of papyrus, section 4.3 the perceived importance of rice and its products, section 4.4 a comparison of the perceived importance of the two resources and section 4.5 the respondents needs and views for the planning and management of the NRW with emphasis to papyrus utilization and rice production.

Perceived benefits of wetland conservation

Table 4.9a shows that the wetlands were viewed as a major source of income 96 (26.45%) respondents, because they provided vast resources that could be used for making market goods. The wetlands were viewed as the main source of livelihood for the community, which provided fish, crops, and plants used for making mats, and therefore the wetlands had to be conserved to avoid overexploitation and destruction. Another 88 (24.24%) reported that the wetlands were very important for agriculture. Discussions with agricultural officers revealed that wetlands had been used for irrigation since the colonial times. The fertile black soils were suitable for large scale growing of rice and sugarcane crops. It was reported that the vast NIB rice fields were formerly natural wetland that had been drained for the growing of rice.

Some 39 (10.74%) of respondents reported that the wetlands hosted a number of valuable plant resources, which had to be conserved and protected. Some 42 (11.57%) reported that the wetlands hosted valuable biodiversity, which included wildlife such as birds, mammals, reptiles and insects. Other important uses of the wetlands

were reported as fishing 14 (3.86%), water for domestic uses 15 (4.13%), to avoid or reduce overexploitation of the resources 34 (9.37%), for grazing 18 (4.96%) and controls floods 17 (4.68%).

However, 18 (33.3 %) of the respondents felt that the NRW had no importance or values because they could not see any tangible benefits from it. They indicated that such areas did not merit conservation because they hosted harmful organisms such as mosquitoes, destructive birds and animals and was also a hindrance to farming. This group suggested that the wetlands be drained completely (Table 4.9b)

4.2.5 Income from the sale of papyrus products

Majority, 105 (90%) respondents were engaged (or had been engaged) in the commercial production and marketing of papyrus products at least a month to the study. Mats were the main products sold 105 (90 %) respondents while chairs, picture frames and ropes were each produced by 4 (3.4 %) of the respondents. There was no significant differences according to sites ($\chi^2 = 9.69$, $p = 0.05$, $d.f=6$) (Table 4.14).

Table 4.15 shows the average weekly production and incomes from mats, chairs, picture frames and ropes in the last month to the study. Four people produced one set (three seater plus two one seaters) each of papyrus chairs in a week. The set was sold for between Ksh. 800 – 1500 with a mean of Ksh. 1150 per week.

Four respondents produced an average of ten (10) picture frames each per week, which they sold at between Ksh. 30 to Ksh. 70 with a mean of be Ksh. 50. Thus the average income from picture frames was Ksh. 500 per week and Ksh.2000 per month. Four (4) respondents produced an average of 20 medium sized ropes per week sold for between ten to twenty shillings each with an average of Ksh. 15. Thus, the average income from papyrus ropes was computed to be about Ksh. 300 per week and Ksh.1200 per month.

4.3.3 The importance attached to rice production in NRW

4.3.4 Income from the production of rice in NRW

The maximum number of bags of rice an individual had obtained in the preceding 12 months was 140, while the mean production in the area was 17 bags (Table 4.20). The average selling price per bag of 90 kg was Ksh. 1612.20 as at November 2000, although responses indicate that it ranged between Ksh. 900-3000 depending on demand and supply forces.

Net incomes from the production of rice computed per 1.5 ha farm was found to range between Ksh. -8000 to 165000 with a mean of Ksh. 25548.00. Farm expenditures stood at Ksh. 7405 per 1.5 ha although that of one farmer was found to be as high as Ksh. 45000 per ha. Rice farming expenses fluctuated based on the labour cost, farm inputs and source of seeds. The main costs involved in rice production included land preparation, seeds, transplanting, weeding, scaring away birds, harvesting, bagging and transportation. Since most of the farmers grew only one rice crop per year, the stated incomes were assumed to reflect their annual income from rice (Table 4.21).

4.4 Comparison of the importance attached to papyrus and rice in NRW.

4.4.1 Levels of importance attached to papyrus and rice in NRW

The study compared the perceived importance attached to papyrus and rice production in the NRW in terms of their benefits to the community. Respondents used a scale of 1-5 (where 1=Very important, 5=Least important). Both papyrus and rice were viewed as being very important as major sources of employment and income for the people. Rice was also important for food, while papyrus was important for building. Both papyrus and rice were viewed as least important for community mobilization. Papyrus was fairly important as fish habitat while rice growing was similarly fairly important as a source of prestige (Table 4.23)

4.4.2 Perceived benefits and costs of wetlands plant clearance

Perceived benefits of wetlands plant clearance

This was evaluated by posing a hypothetical question of a scenario where all the wetlands had been converted to agricultural production. Most respondents, 93 (77.6%) reasoned that there could be great increase in the incomes from agricultural production (including rice, horticulture, and maize) and an increase in some useful birds like ducks that could be used as food. However, 27 (22.4 %) respondents did not foresee any benefits to the community were the wetlands to be cleared. Group discussion revealed that the community perceived that it would benefit much if papyrus were cleared. This would result in improved flow of water along the river channels for irrigation and thus reduced flooding during the rain season. It would also result in the decline of birds such as *Quellea quellea*, destructive to rice and mosquitoes, Tse Tse flies and other microorganisms that caused ill health to humans and domestic animals.

Table 4.23: Levels of importance attached to papyrus and rice in the NRW

Perceived benefit or importance attached	Level of importance attached to:	
	Papyrus	Rice
Is a source of employment for majority of people	● ● ● ● ●	● ● ● ● ●
Major source of income	● ● ● ● ●	● ● ● ● ●
Is a source human food	●	● ● ● ● ●
Source of building material	● ● ● ● ●	● ●
Forum for community interaction	● ● ●	● ● ●
Used to make brooms	● ● ●	●
Source of livestock fodder	● ●	●
Is habitat for fish	● ● ● ●	●
Can make paper/soft board	●	●
Has potential for tourism	● ●	●
Source of prestige	●	● ● ● ●
Source of chicken feed	●	● ● ●
Source of manure/fertility	●	●
Source of fuel	● ●	●
Help purify water	●	●

Key: Very important ● ● ● ● ●
 Fairly important ● ● ● ●
 Important ● ● ●
 Not important ● ●
 Least important ●

Perceived costs of wetlands plant clearance

According to 79 (66 %) of the respondent there could be reduced incomes especially for those who depended on wetland plants such as papyrus for mat making. Another 13 (11.3%) mentioned the potential loss of important wetland plant and animal species used for food, while 16 (13.2%) reported that there could be great loss of grazing land. In addition, 5 (3.8 %) reported that there could be increased drought, 2 (1.9 %) stated that there could be increase in floods and in the amount of mosquitoes especially around their homes. About 5 (3.8%) reported that there could be over utilization of land resulting in the lowering of soil fertility.

A group of women mentioned that although rice had high incomes, working in it often caused sickness and destruction of houses by overflowing water from the farms. Furthermore, rice growers were usually faced with a lot of problems when trying to sell it including delay in payment by major buyers. One respondent, mentioned that reclaiming the wetlands and converting it to large scale plantations of rice could be a costly venture. According to that respondent, the value of papyrus in maintaining the local economy was immeasurable. Furthermore, the wetlands had valuable biological resources such as fish , which could be eaten by the local people. In addition to the above, he also mentioned that converting the wetland to agricultural production would be an exercise in futility because the moment the rains came, the farms would be flooded and the crops destroyed thus the need to conserve the wetlands in their natural state.

4.4.3 Perceived benefits and costs of wetland plants conservation

Perceived benefits of conserving wetland plants

The study established that many respondents valued papyrus and other wetland macrophytes and preferred their conservation. Two thirds (80) of the respondents mentioned that with their conservation, there could be a great increase in the incomes obtained from papyrus products. According to these respondents, papyrus was the Luo proverbial black cow “ *dher rateng*” which provided milk (income) throughout the year. Some 7 (5.6 %) mentioned that there could be an increase in important wildlife [including *Tragelaphus spp.* (Sitatunga)] while 3 (2.8 %) believed that the amount of the fish catch would increase, and another 3 (2.8 %) stated that there could be an improvement in the weather conditions. However, 27 (22.1 %) of the respondents reported that they did not foresee any tangible benefits to

the community by conserving the wetland plants. A group of women revealed that they perceived papyrus to be the backbone of their economy and if anything (negative) were to happen to it, they (women) would suffer most.

Perceived costs of wetland plants conservation

The study found that 82 (68 %) of the respondents believed there could be an increase in the amount of harmful insects, such as mosquitoes, if papyrus was conserved. In addition, 5 (4 %) said that there could be overproduction of mats which would lead to a drop in the value of mats and thus lowering the incomes for the people. Another 29 (24 %) reported that wetland conservation would lead to the loss of agricultural land, and thus the dwindling in the income for farmers. However, 5 (4 %) of the respondents mentioned that they did not know what would happen. Thus the community perceived the conservation or reclamation of the NRW to have costs and benefits to them. In that respect, measures had to be devised to ensure a balance was met as concerning the use of the wetlands.

4.4.5 Product perceived to have more value

The respondents evaluated the costs and benefits of engaging in the two enterprises. Results show that 65 (54.2 %) perceived rice to be more important than papyrus in terms of the overall benefits of engaging in its production, while 47 (39.2 %) perceived papyrus to be more important. However, some 8 (6.7 %) respondents could not explicitly say which product had more benefits than the other. Differences in perceptions of commodity with more importance was significant, ($\chi^2 = 42.5$, $p = 0.05$, $df=2$). (Figure 4.2).

4.4.6 Monthly household incomes from rice and mat making

Comparative incomes from rice and papyrus products were established. As earlier established, average income from papyrus mats, chairs, picture frames and rope making were quite high. However, because mat making was the most common use of papyrus, incomes from it were compared with that from rice. Table 4.25 shows the average monthly income accruing to households from mat making and rice sales.

These results indicate that households received more income from rice compared to mat making. However, these estimates could be misleading because the respondents did not keep proper records of their transactions. Furthermore, incomes from the products were greatly affected by seasonality, supply and demand forces and external factors like the government, which influenced the prices of rice. In addition, most of the respondents did not specialize in the production of any one of the items continuously. On the other hand, they produced the various products depending on the season. However, the results give an insight of the possible incomes that may be derived from the resources.

The mean incomes from the two resources were compared. Analysis of Variance (ANOVA) test indicate that there were no significant difference between the mean incomes of the two major resources. No two groups were significantly different at 95% confidence level. [F. (6, 79) =0.651, P= 0.05]

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

Results show that the community highly values the wetlands and the products that come from them. The wetlands are considered important for socio-economic and environmental reasons and are used to satisfy those needs. However, uncontrolled uses may result to wetland degradation. It is also evident that community participation is required in any endeavour to conserve the wetlands. Management options must take into account the social, economic and environmental importance of the wetlands to the community.

Conservation of the wetlands will succeed when the important uses the community has for the wetlands are taken into account and promoted. The increased dependence on the wetlands for the provision of daily needs confirm the fact that all stakeholders must continue consulting on the best way to make use of the wetlands without impacting negatively on the ecosystem.

The theory of the “Tragedy of the Commons” has been used to demonstrate wetland management challenges while the “Wise Use Concept” and the “Theory of Environmental Planning and Management” have proved essential in the development of a management strategy for the wetlands. This study is therefore a landmark in trying to show that the Lake Victoria wetlands are important resources for the riparian communities and their conservation ought to be given greater attention than has been done previously.

Just like the conservation of other fragile ecosystems such as forests, the conservation of the NRW must involve all stakeholders. Special efforts must be taken to include the needs of various sectors of the community. Furthermore, there is need for the execution of an environmental impact assessment whenever the wetlands are to be converted to any other use. Such assessment must take into account the real and the potential costs and benefits of the proposed activity.

6.2 Conclusion

The study has established that the NRW community perceives the wetlands to be important mainly for food, building materials, biodiversity and for grazing and therefore important for conservation. These findings are important in that it enables a policy maker know from the onset that the resources to be conserved are important to the immediate community which depends on them.

Papyrus is the most common and important wetland plant. It is used for both subsistence and commercial production of mats, ropes, baskets and for thatching. With wise use training offered by local NGOs notably the NWCP, products from papyrus have appreciated in value and can fetch more incomes while at the same time consuming smaller amounts of raw materials. However, engaging in papyrus processing has many socio-economic problems while its degradation is mainly caused by over harvesting and fire which result in scarcity of the plant.

The most common cash crop in the NRW is rice which is considered a major cash earner for the community, source of food and also prestigious to grow. Due to socio-economic and environmental factors, the production and incomes from rice have been diminishing in the recent years. This often results to increased encroachment of the wetlands in order for one to gain more land for agriculture. Engaging rice production has socio-economic and environmental costs.

Due to increasing demand for agricultural land, seasonal drought and poverty, the wetlands are continuously reclaimed. This results to degradation, land use conflicts as well as human-wildlife conflicts.

Differences in the mean incomes from mat making and rice were found to be insignificant. It was established that incomes from rice and papyrus were comparable. However, majority preferred rice to papyrus products. There was no significant relationship between perceptions of the most important enterprise in relation to hypothesized demographic factors namely age, sex, education, income and distance to the wetlands. However, papyrus was perceived to be very important in sites C and B where it was abundant compared to where it was scarce.

Both enterprises have several constraints or dis-advantages to the community. However, there exists a potential for the integration of environmental concerns and socio-economic needs in an attempt to manage wetland utilization challenges. Although agricultural products such as rice is perceived to have more direct economic

returns, the community desires that a balance be observed in the use of the wetlands so that natural plants are not degraded, but instead conserved because of their benefits.

To achieve sustainable utilization and management of the wetlands, the community needs education and training, involvement in decision making through stronger co-operative societies, incentives for conservation, regulations in the use of the wetlands, widening of marketing opportunities, continuous wetlands monitoring, evaluation and information exchange.

A co-management initiative would greatly facilitate the planning and implementation of sustainable management and conservation of NRW. This would ensure a constant income for the people while at the same time ensuring that the wetlands are conserved. Incomes from papyrus could be higher especially if the products produced were of higher quality and when there was proper planning of the activities in the wetlands. Thus wise use efforts ought to show the ability for the community to earn more while at the same time conserving the wetlands.

In terms of theory, this study has shown that the theory of the Tragedy of the Commons is essential in perceiving the community response to wetland management challenges. Through democratic participation successful wetland management may be achieved. The results serve to build on the Wise Use Concept and also reveal its applicability to the conservation of wetlands, namely that satisfaction of human needs may result in increased appreciation and conservation of the resources that satisfy those needs.

This study contends that the Wise Use of wetlands concept and the theory of Environmental Planning and Management are useful for riparian communities, policy makers, planners and professionals who endeavour to deal with issues concerning wetlands management. This study being the first one of its kind in the Lake Victoria basin especially in the Kenyan side, provides important information needed for planning the conservation of the fragile wetland ecosystems in the region based on wise use. The specific consumers of this study findings will include the local communities, agricultural extension officers, NWCP, LVEMP, KWS and Contracting parties to the Ramsar Convention.

6.3 Recommendations

From the study, the following recommendations are made:

1. Strengthen community participation.

This should be done by creating awareness of the importance of wetland conservation and enhancing skills for the production of high quality products from wetlands. Hence CBOs with membership composed of men, women and youth should be started. In addition, there is need to provide incentives and support in order to raise enthusiasm and participation in management of NRW. There is need to encourage a sense of social responsibility and stewardship for wetland conservation.

1. Regulate the harvesting of wetland resources.

Rotational harvesting should be encouraged to regulate the harvesting of wetland plant resources. This entails the communities harvesting papyrus in a particular zone for sometimes, then moving on to another zone while leaving the first zone to recover. The use of fire by fishermen or any other individual should be banned.

3. Establish wetland management zones

The aerial extent of NRW should be clearly demarcated and existing regulations for deterring unsustainable use enforced. Furthermore there is need to rehabilitate some parts of the wetlands such as the Okana swamp with involvement of the community.

4. Monitoring and evaluation

There should be continuous monitoring and evaluation of social, economic and environmental changes and problems related to the use of the wetlands. A early warning system involving the local people should be established to bring to the attention development planners any harmful in the wetlands which might need emergency attention.

5. Develop a comprehensive wetland management policy and a long-term management plan for NRW.

This policy should include inter-sectoral collaboration, community involvement, income generation and sustainability. Local wetland management committees may be involved in mapping out additional strategies on how to protect and utilize the wetlands sustainably.

7. Areas for further research

This study can be viewed as an eye opener since it provides valuable data on the importance of the NRW to the community, the rationale for their conservation and on the role of the community in their conservation.

However, further research should be conducted to:

- i. Investigate the social, economic, cultural and environmental values of other wetland products and their wise use.
- ii. Study the annual income accruing to Kisumu and Nyando districts from the sale of wetland products such as mats, baskets and chairs.
- iii. Investigate medicinal plants available in the NRW.
- iv. Investigate the potential for eco-tourism in NRW.