THE CHANGING WETLAND USE AND ITS IMPLICATIONS IN MUMIAS DIVISION, KAKAMEGA DISTRICT, KENYA.

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A THESIS SUBMITED IN PARTIAL FULFILMENT FOR THE DEGREE OF MASTER OF ENVIRONMENTAL SCIENCE IN THE FACULTY OF ENVIRONMENTAL STUDIES KENYATTA UNIVERSITY.

1996

D E C L A R A T I O N

This thesis is my original work.
It has not been presented for a degree in any other University.

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ABSTRACT

This study examines the changing wetland use and its environmental implications in Mumias Division, Kakamega District. The aim is to highlight the changing use of wetlands and its environmental implications to the community in particular and environment at large. The study specifically investigates the changes in wetland acquisition, ownership and use with respect to its conservation. It determines the socio-economic patterns influencing wetland's changing use and shows how the process of increasing wetland human encroachment relates to the environment by pinpointing the impact that this practice has to the environment and the community.

Archival records, oral interviews, questionnaires and repertory grid were the methods used in the collection of various kinds of information relating to wetland use in the study area. The data from archival records and oral interviews were qualitatively reported, while data collected using the other methods were subjected to various statistical interpretation and analyzed both quantitatively and qualitatively.

The study indicates that wetlands in the pre-colonial times were a shared resource that received both individual and communal protection hence being sustainably used. Colonial rule brought with it individualisation of wetlands and changes in their use which influenced wetland loss. The number of years that the wetland has been under utilisation were found to be associated

with the percentage of wetland cultivated. There is a linear relationship between family size and the percentage of wetland cultivated. Land-demographic background of the wetland farmer and financial gains from the wetland produce were seen as factors influencing wetland loss in the area under study. Fuelwood, water in wells, construction materials and forage are wetland resources of importance whose unavailability is affecting the community significantly. Changes in soil acidity, reduction in biodiversity, loss of river bank protection, downstream flooding and increased sedimentation are inferred to be some of the ecological problems resulting from wetlands' changing use.

The study points to the facts that; to reach certain policy decisions regarding the use of a resource; it is necessary to understand people's way of life by looking at trends of the resource use, the socioeconomic push factors behind the change in use and the impacts of the changed use. It's after this that appropriate resource use innovations can be advocated. Consequently, it is suggested in the study that the approach and methodology used can be valuable to a holistic analysis and understanding of imposing preconceived notions of them. The study also shows that the government agricultural policies have tended to favour economic goals in the farming pursuits with less consideration of other needs that an individual may have from the same resource. It is therefore recommended that the government should involve the local people as participants in the planning and development of wetlands. The government also needs to adopt a strategy of integrated wetland management .

ACKNOWLEDGEMENT.

I would first like to acknowledge the assistance obtained from Kenyatta University Postgraduate Studies Committee for awarding me a scholarship and paying for my two year study.

I wish to express sincere appreciation to Mrs. Zipporah Rimbui, my supervisor for her advice, guidance, suggestions and constructive criticisms of this thesis together with Mr. J. Koske who in the process left for further studies. To these two I say thanks alot. I also wish to thank most sincerely, Professor Korir Koech, Dr. R.K. Kerich, Dr. S. Mutiso, Mr. D.G. Mang'uriu, Mr. N.T. Muthiani, Miss E. Marekia, Mrs. M.G. Karembu, Mr. P.K. Koske and the entire staff of the faculty of Environmental Studies 1991-1992 whose lectures and lovely discussions during my coursework stimulated my interest in this study.

Sincere thanks are to my late father Wilson Chitechi, my mother Wilbroda Maende, Mr. and Mrs. Mohammed Wambani and Rev. James Matanga, my uncle for their moral, financial support and guidance throughout my school life.

I would like to express my profound gratitude to my beloved husband, Fanuel Wemali, for his patience, encouragement, moral, support, emotional, financial and guidance throughout my Masters degree work and for learning to cope with my absence from home due to this study. Iam also indebted to him for the computer word processing and printing. To you I say thank you.

A special word of thanks to Mr. M. Khayesi for his contributions towards this study. I cannot forget to thank Paul Ngetich, Wilberforce Wangalwa, Violet Wawire, Daniel Wesonga, Mary Kibathi, colleagues in a similar struggle and many others whose company, criticisms, suggestions contributed immensely to this study.

Sincere thanks are to all those wetland farmers I visited during the field research. Iam also grateful to all persons not mentioned who in one way or another contributed to this study.

I cannot forget to thank Mr. Augustus Egesa for his encouragement and moral support.

Finally, thanks are due to the almighty God the all knowing source of wisdom and of all blessings.

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CHAPTER ONE:

INTRODUCTION.

1.1 Background.

The world is presently undergoing an environmental crisis which is manifested in the widespread destruction of ecosystems and the consequent loss of biological species. This crisis has been attributed to the increasing human population and its rising aspirations and to the patterns of economic and technological development (Ward; 1972, Green; 1985). Current systems of economic planning and methods of production are seen not to be conducive to promoting environmental security largely because they are not aimed at achieving sustainable development. As human population rises its aspirations and immediate human needs take prominence. The development activities that come up to cater for these needs more often than not tend to ignore and undermine the value of natural resources such as forests, marine and freshwater wetlands. Loss of these ecosystems and therefore the species therein is not just a sign of loss of biological richness but also of genetic potential and hence a reduction in the security of the biosphere (UNEP Report; 1990).

Wetlands:- riverine areas of marsh, swamp, bogs and riverine forest have been under human management for a long time, effectively contributing to the well being of the surrounding communities and even the wider nation. Wetlands are important ecosystems whose functions and values are varied depending on the nature of the wetland. They are seen as important components of the hydrological cycle. They serve as natural water storage and discharge reservoirs hence regulate stream flow and water volume

of the surrounding water bodies. Wetlands absorb and dissipate the forces of the storms and floods hence a protective measure against downstream flooding. They also act as a protective mechanism against river water pollution as they act as silt traps for water flowing through them hence reducing the amount of silting downstream. Wetland also remove large amounts of nutrients from the nutrient loaded waters which flow through them hence reducing eutrophication. In addition, wetlands are breeding, rearing and feeding habitats of many wetland species. They are a habitat of sitatunga (Tragelaphus spekei) while the hippopotamii (Hippopotamus amphibius) uses the wetland as its feeding ground. Other animals common in the wetlands include birds such as the goliath heron (Ardea goliath) and the pied kingfisher (Ceryle rudis) and the lung fish (Protopterus and Polypterus Species)* .

The communities that live near wetlands draw food, medicinal plants, fuel wood, materials for building, clean water for both livestock and domestic uses, raw materials for handcrafts such as basketry, pottery and mat making to mention but afew (Mavuti; 1989, Kareri; 1992). The wetland soils are also viewed as fertile and well watered and hence of high potential for agricultural development. This gives a strong case for wetland reclamation. Despite all the ecological and socio-economic benefits cited above, the wetlands are unfortunately looked upon as wastelands and a hindrance to progress. They are associated with breeding grounds for snails and mosquitoes which transmit bilharzia and malaria respectively. Recent reports

* Journal of resource Vol. 1 No 1.

have, however, shown that they are continuously being changed to become sites for settlements, industrial projects, dumping grounds, subsistence and commercial agriculture (Howard and Thompson; 1985, Muthuri; 1989, Dugan; 1990, Gichuki; 1992, Mavuti; 1992). This trend has been observed to be particularly true for the unprotected wetlands in high and medium potential areas where human activities for wetland reclamation are on the increase.

Wetlands all over the world are under great pressure to be eradicated. In United States, some 54 per cent (an equivalent to 87 million hectares) of its original wetlands are lost while in western France 80 per cent of the marshes of the Landes have been drained (Dugan, 1990:33;). Here in Africa, the Sudd swamps on the Nile are seen as a hindrance to communication. After completion, the Junglei Canal will channel the waters of the white Nile to bypass the swamps. This will result in the draining of the Nile basin swamps to increase water for irrigation in the northern semi-arid Sudan (Muthuri; 1989). In Rwanda and Burundi, it has been observed that due to shortage of agricultural land, the swamps are being cleared, drained and planted with rice, maize and sweet potatoes. In Uganda, the wetlands are at the moment reclaimed for rice and the cultivation of other crops especially around Lake Kyoga (Mwaka; 1989).

Kenya's wetlands cover 14,000 km^2 (Kareri; 1992). These ecosystems are however faced with threats from pollution, over-exploitation, land degradation, damming, siltation and agricultural development just to mention but afew. To this effect, Kenya has established various parks and reserves to

protect some large wetlands. Such parks and reserves include the Mzima springs, Lake Nakuru, Lake Bogoria and Tana river primate etc. The conservation of such wetland apart from earning Kenya the most needed foreign exchange has above all enabled the country to conserve her heritage which can be utilized in many other ways including education. In addition, the conservation of wetlands has enabled the country to protect some endangered species for instance the flamingoes on Lake Nakuru. There are other unprotected wetlands that are under very great pressure for eradication, the Tana delta being at the forefront. These wetlands have an abundance bird life and a variety of fish species. In addition to that, the aquatic grasses are harvested as fodder for milk cows and calves while sedges are used for thatching (cited by Mavuti 1992 from GOK 1991). Their destruction will thus cause havoc to the community that relies on them for subsistence and the ecology in general.

The Yala swamps are also faced with destruction from the agricultural sector which saw 938.6 acres drained by 1980 (Mavuti; 1992). The papyrus swamps around Lake Naivasha are also being cleared to give way to agricultural crops. Other wetlands under pressure are the deltaic grass swamp of the Kano plains whose 2099.5 acres have been reclaimed at Ahero and 2223 acres in West Kano. The two reclaimed schemes are under sugar cane and rice cultivation.

In general, the grass swamps in Kenya are continously being converted into agricultural use hence few are being conserved. Many have come to believe that Kenya needs food more than idle natural swamps (Okondo; 1989). Due to this, the reclamation of

the wetlands is seen as legitimate and justified. In Mumias Division the study area, reclamation of the poorly drained lands (wetland) can conceptually be divided into two:
that done by the farmer and his or her household on his farm and that which is government aided with the help of extension officers. The former is not documented as is done on individual basis, while the latter is, giving figures in the table below which shows the drain length dug in 1992 in the division.

Table 1.1: Drain length dug per location in 1992.

Location	Drain length (acres)
North Wanga	17,043
West Wanga	12,597
Central Wanga	38,285
East Wanga	15,314
South Wanga	15,067
TOTAL	98,306

Source: Mumias Division annual agricultural report 1992.

Although large areas have been reclaimed in this area, little research has been undertaken to study environmental implications of draining the wetlands. This study is aimed at bridging this knowledge gap with a view of coming up with means and ways of sustainably using the wetlands resources in the area.

1.2 Statement of the problem.

The wetland areas that now remain in Mumias Division, which is under study, are generally riverine thickets, freshwater tree swamps and marshes. These offer diverse ecological and socio-economic benefit but at the moment are experiencing different levels of human interference. The human activities encroaching on these wetlands at present include settlement, industrial (Mumias sugar factory on river Nzoia) and agriculture. Although this happens to be the case, many households in this area are dependent on wetland resources for their livelihood in addition to the day to day requirements of construction materials, forage and firewood. As a result of the human activities, the area under natural wetlands in Mumias continue to shrink. Realising the magnitude of the problem, the study seeks to find out the trends in wetland, acquisition, ownership, and use, the social economic forces behind the changing wetland use, the environmental impacts and hence the environmental implications of this phenomenon.

1.3 Objectives of the study.

Broadly, the study investigates the environmental implications of wetlands changing use in Mumias Division together with the socio-economic factors influencing the practice.

The specific objectives are as follows:

1. To investigate the changes in wetland acquisition, ownership and use with respect to wetland conservation.
2. To determine which socio-economic factors influence people's use of wetland areas in Mumias Division.

3. To investigate the resultant impact of wetland use to the surrounding environment and community, and on the basis of this, to suggest some policy implications and line of action to guide the sustainable use of wetland areas in Mumias in particular and Kenya in general.

1.4 Research hypotheses.

1. Socio-economic characteristics of a farmer influence the percentage of wetland cultivated.
2. Certain patterns of interdependence among the selected socio-economic variables influence the percentage of wetland cultivated.
3. The use of wetland areas for agriculture has negatively affected the availability of certain natural wetland resources.

1.5 Assumptions of the study.

During the study, the following assumptions were made:

1. It was assumed that the time lapse during the field research did not significantly affect the results of the study. Hence any marked variations between the observations would only be attributed to a much longer period of time.
2. It was also assumed that the respondents clearly understood the questions they were asked and that their responses were a true indication of the real situation.

1.6 Rationale of the study

Except for the studies done independently on agricultural land use and wetland dynamics, little has been done on wetlands as agricultural land in Mumias Division and its environmental implications. Therefore, this study focuses on environmental implications of wetlands changing use as a contribution to the growth of environmental science knowledge. The study endeavours to consider the socio-economic forces behind wetlands changing use as this is crucial in understanding the changing wetland use pattern, accessibility and allocation.

As mentioned, many households in the study area depend on the wetlands for their livelihood. Therefore, it is desirable that mechanisms for sustainable wetland use be developed and promoted. It is hoped that the study findings will help wetland owners to sustainably use their wetland resources thereby helping them to raise their income levels and quality of life through improved wetland use techniques that are environmentally friendly.

To meet the challenges of attaining economic growth of 5.6 percent per annum, the Kenya government has assigned the agricultural sector a priority role of contributing 5.3 percent of the target(Kenya 1989). This implies that increased agricultural production is mandatory. In the Sixth Development Plan Various measures were considered important in attaining this goal. One of the measures which is the subject of this study is the expansion of the arable land to include the marshes and the swamps in the lowlands (Kakamega District

development plan; 1989/1993). This is further strengthened by government policy of adopting small holder irrigation schemes based on self managing groups of farmers with technical advisory support from the government. The achievement of this goal in wetlands will largely depend on their efficient and sustainable use. By eliciting the likely environmental implications of wetlands changing use, the study findings will help eliminate dis-economies, maximise positive impacts while lessening undesirable impacts. This will thus help support a productive agricultural sector through environmentally sound and efficient management of the wetland resources.

Wetlands are very valuable resources not only to the local community that live near them but also to the entire country because of their unique functions and values. Information concerning the environmental implications of their loss serves to inform the local people and the rest of Kenyan communities of the consequences of the wetland loss. The study findings will thus result in environmental awareness of environmental relationships.This awareness may partly help change peoples attitudes towards wetlands from that of an obstacle to development to that of an asset which can be sustainably used and hence the need to conserve.

The study findings will enable the policy makers to expand the range of environmental considerations as they deliberate on wetlands as agricultural lands. This will then enable them to recognise thresholds and to define limits of wetland use in an attempt to conserve the fragile ecosystems.

The RAMSAR Convention held in Iran on 2nd February 1971, recognised the fundamental ecological functions of wetlands and their economic, scientific, recreational, cultural and educational values. To this effect, the convention urges member states to convene advisory conferences on the conservation of wetlands and water falls. Kenya being a signatory to the convention, the findings of this study will contribute to creating more environmental conscious plans concerning Kenya's wetlands thereby eliminating costly environmental damages. These findings may be passed to other natural resource base of the country and the general public.

Finally, the findings of this study will contribute to the data base and framework for further research, and continuous monitoring and evaluation of wetlands changing use.

1.7 Study area

Mumias division is one of the administrative areas in Kakamega District, the other divisions being Butere, Ikolomani, Kabras, Kakamega municipality, Khwisero, Lugari, Lurambi, and Shinyalu. The inhabitants of the Division are the Wanga people a subgroup of the Luhyia. These form the majority although there are other ethnic groups as well. The division lies entirely within the sugar cane zone. It covers an area of 586 km^2. It is located approximately between latitudes 0^0 and 0^0 30'N and between longitudes 34^0 E and 35^0 E. The altitude ranges between 1800m and 2000m with 60% reliability (Jaetzold and schmidt; 1983). The area experiences both long and short rains between late February and May and August and November

respectively. December and January are generally dry months. The annual mean temperature range from 20.8 ^{0}C to 22.0 ^{0}C.

Mumias Division has its headquarters in Mumias township. It is divided into 5 administrative locations and 25 sub-locations. The locations are : North Wanga, South Wanga, Mumias central, East Wanga and West Wanga. According to the 1979 population census the area had a population of 132,775 people. The projected population for 1983 was 156,988 people, for 1988, 186,630 and 215,085 people for 1993 (Kakamega district development plan; 1989/1993). Mumias Urban centre had an estimated population of 12,300 in 1983 and 18,880 for 1988 while the estimate for 1993 stands at 29,049. The Division has a high population growth rate and with the highest population in the district.

The region was heavily forested several hundred years ago but at present, it consists mainly of grassland with small patches of indigenous woodland. The division is made of Kavirondan and Nyanzan rock systems. The well drained soils on lower level uplands are developed from various rocks of Kavirondo sediments and basic igneous. The lowland soils can be divided into two groups:-

1) Soils that border the well drained upland region. These are imperfectly drained to poorly drained deep grey sandy clay to clay with very dark greyish stratified top soil. The top soils are sticky plastic friable sandy loam to sandy clay loam.
2) Soils within the water-logged poorly drained region. These soils are poorly drained deep brownish grey to

mottled firm sandy clay to clay.

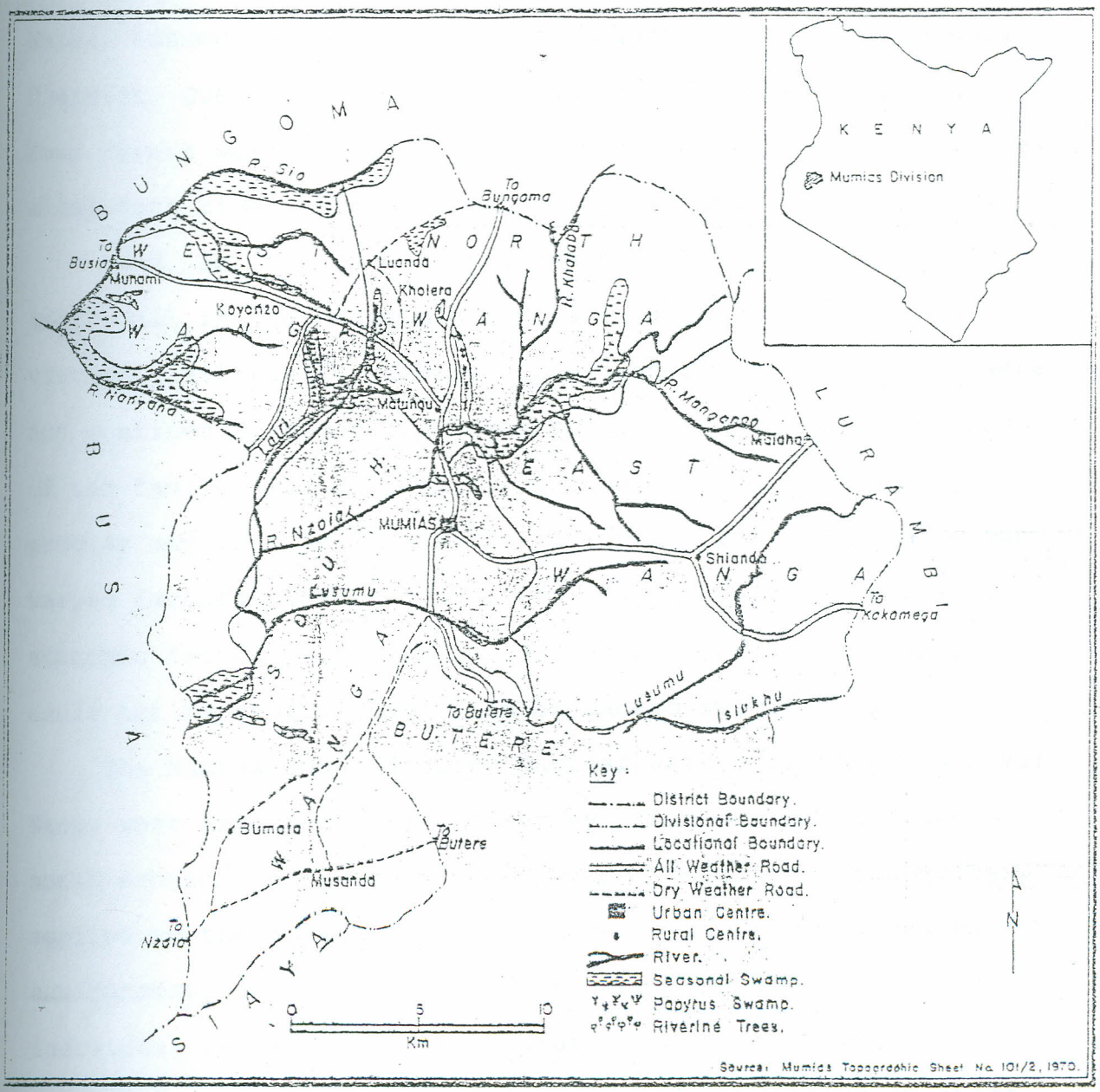
Vegetation prevalent in the lowlands include reeds (*Phragmites*), Sedges (*Lyperus cladium*) and grasses such as *Rossia* and *Londetia*.These lowland soils in some places form swamps and marshes. This study was undertaken to make findings in the changing use of these wetlands along rivers Nzoia, Suwo, Lairi and Lusumu (map: 1) where the wetlands are prevalent. These four rivers are also the main ones that drain the area under study.

The division ranks as one of the highest potential agricultural divisions of Kakamega District. However, parts of the division have soils of low agricultural potential (Kakamega District development plan 1989/1993). Farmers in this division face a dual problem of poor yields from subsistence crops and a shortage of cash for on-farm investments (Barclay; 1977).

Upland soils in this area tend to be granitic heavily eroded and deficient in phosphate and other nutrients (Barclay; 1977). The large expanses of wetlands that adjoin the Nzoia river and its tributaries such as Lusumu and Lairi are difficult to manage without thorough drainage or else the crops planted in them tend to become waterlogged. There is a general decline in cattle population relative to human population (Jaezdolt and Schmidt; 1983), hence use of animal manure is limited. Many farmers who have cattle have largely used the wetlands for pasturing their animals. This,however, is now changing, many wetlands being turned to agricultural fields. Sugar cane is the main cash crop grown in this

Division, Subsistence crops grown include maize, sorghum, finger millet, beans and cooking bananas.

MAP: 1 WETLAND AREAS IN MUMIAS DIVISION.



Source: Mumias Topographic Sheet No. 101/2, 1970.

1.8 Scope and limitation of the study

This study is confined to the wetland areas along Rivers Nzoia, Lusumu, Suwo and Lairi in Mumias Division of Kakamega District. Due to time available not all farmers along these four rivers were included in the study. A sample of 25 farmers along each river were systematically selected for interview.

Land use is a complex process that hardly involves an individual in the household but is made in consultation with virtually all family members. Consequently the interviews were not confined to household heads but included several members of the family. The complexity of land use decision making process may in itself be a limitation as it would involve many varied factors. The study as such, examined only a few socio-economic factors (chapter 4) leaving out many others which could not be easily quantified or lacked specificity.

The Mumias Sugar factory nuclear estate farms along River Nzoia were excluded from the survey. This was because the socio-economic parameters under study could not be adequately applied to the estate farms. To have to reconstruct the past environment, there was heavy dependence on reports by individual persons and the records from the archives. The degree of accuracy of the reports therefore depends on those who reported. It was expected, however, that some error would be incorporated. Various persons in the village were asked similar questions, the answers given were corroborated with the records from the archives, any anomalies in the reporting from either side were discarded hence minimising the error.

The kind of land use in the wetlands was generalised to be agricultural since it is the most prevalent.

1.9 Definition of terms

1.) Educational level

The level at which one left formal schooling. This was categorised into none (nil), primary, secondary and post secondary.

2.) Environment

The sum-total of one's surrounding be it of a plant or an animal. It encompasses the biotic and the abiotic factors that surround an organism.

3.) Family size

The number of persons in each homestead including husband, wives and children of all ages and any other member who depends on the household farm for subsistence.

4.) Farm size

Total land acreage under crop, livestock, residential, fallow, and unused land under the jurisdiction of an individual.

5.) Household

A person or a group of persons living together under one roof or several roofs within the same compound or homestead area and sharing a community of life by their dependence on a common holding as a source of income and food which usually but not necessarily involves them in eating from a "common pot".

6.) Length of time that the wetland has been in use

Time (in years) that the wetland has been under crop cultivation.

7.) Off farm occupation

Occupation or salaried employment outside farm work which the household head engages in.

8.) Wetland

Areas of marsh, swamp and or riverine forest with fresh water that is static or flowing, permanent or temporary, the depth of which at low tide does not exceed six metres.

9.) Wetland tenure system

The mode of ownership of the wetland such as inherited, rented or bought.

10.) Purpose of wetland produce

The ultimate destination of the crops produced from the wetland that is, whether they are for marketing, subsistence or both.

CHAPTER 2

LITERATURE REVIEW

2.1) Introduction

Freshwater and wetland ecosystems cover large parts of the surface of the earth. These are productive ecosystems which can play a central role in strategies for sustainable socio-economic development. Wetlands are drained to enhance the health and welfare of human society but the rate at which this is done, and hence destroyed is so high that wetland destruction comes second to deforestation (Green; 1985). If well managed, wetlands can help meet the needs of a rising population while their degradation can worsen the pressures upon rural communities (Dugan; 1990:5). Africa supports a relatively large area of wetland covering 345,000 km^2 or 1 per cent of the total land (Denny; 1985). The area of these wetlands which are however in some way protected is inadequate as a large portion of it is on private land and unprotected. Although less than 3 per cent of the area of Kenya is occupied with swamp, swamp conservation does not receive adequate attention.

The Literature reviewed was broadly divided into 2 sections. Section 2.2 deals with factors influencing land use patterns while section 2.3 deals with wetlands and human influence.

2.2) Factors influencing land use patterns and decision making.

There are two approaches that have been used to explain patterns of land use. One approach emphasises the role of the physical environment while the other is based on the assumption that land use is an economic activity determined by economic forces (Mather; 1986). The physical environment basis of land use rests on the belief that the nature of the environment has the ability to limit human endeavour. It speculates that the nature retains casual power over the actions of man and that culture and social institutions are responses to environmental conditions (Moors; 1934). It has however come to be realised that land use is also a product of human decision. This emphasizes that although the environment and the economics exert a strong influence on land use the two; physical environment and economics do not operate in a direct and automatic fashion (Mather; 1976). Thus to understand patterns of land use, human decision and the making of the decisions should be understood.

There are many factors that tend to affect decision making concerning land use. In a study done to determine decision making factors in land use, factors of importance were ranked. Three of the factors were of economic nature which related to profit and stability (Illbery; 1979).

Another study done in Trans-Nzoia district on agricultural decision making and farmers choice of strategies, showed that non-economic factors such as security of subsistence requirements, knowledge and experience and

predispositions have a very significant influence on the choice of farming strategies while the selected socioeconomic variables such as the age of the household head number, number of persons in the farm household and employment outside did not have a significant influence (Naulikha; 1990). In another study in Kiambu district on factors affecting roadside farming, financial gains derived from roadside farm produce, the search of vacant road reserves for cultivation of food crops for domestic consumption and of marketing purposes and lack of adequate family holdings were some of the reasons behind roadside farming (Mbwesa; 1990).

Farm size, type of land ownership and off-farm occupation influence decision making about land use (Mather; 1986, Found; 1966). It was shown that there is an inverse relationship between farm size and intensity (Mather; 1986) while in the study done in central Jamaica, it was shown that increase in farm size is associated with increase in production (Found 1966). The same study showed that the type of land use and agricultural income will change with acreage in the farm size while off-farm occupation was shown to be associated with decrease in production. Although these studies reveal the factors in decision making that influence production and income, they however fail to address the effect of these socio-economic factors on the extent of cultivation. The current study intends to find out how farm size, land ownership, family size and off-farm occupation among other socio-economic factors would influence the size of the wetland cultivated.

Perception of the environmental hazards such as flooding was seen to be affected by a range of personal factors such as age and personality (Mather; 1986). It is seen to be related to attitude of risk and uncertainty in land enterprises. These results imply that the way a land user perceives his environment and his subjective view of actual or potential hazards will strongly condition his choice of use and form of management. Age is seen as a significant factor in environmental perception about the adoption of innovations. It is also significant in relation to the value and objectives of a land user. This study was designed to find out if such socio-personal factor such as age is a factor on the extent of the wetland cultivated.

2.3 Human influence on the wetlands:

The Ramsar convention defines wetland as: "areas of marsh fen, peatland or water whether natural or artificial permanent or temporary with water that is static or flowing, fresh or brackish or salty including areas of marine water the depth of which at low tides does not exceed six metres." (Dugan; 1990).

Many wetlands support important migratory fish and bird populations. This aspect led to the Ramsar convention held in Iran in 1971 and whose main aim came into force on 21/12/1975 to halt the decline of wetland habitats globally and maintain their ecological and wildlife functions.

Under the convention, the contracting countries agreed to

include wetland conservation in national planning to promote sound utilization of wetlands, to create wardened nature reserves and to facilitate wetland based research (Kerry; 1991).

Wetland ecosystems account for 6 percent of the global land area and are among the most threatened of all environmental resources (Kerry; 1991). He notes that development projects have stimulated wetland conversion largely because of information failure and policy interventions which have been badly coordinated or poorly designed. He contents that in Peninsular Malaysia many fresh water swamps have been drained for rice cultivation but yields have been disappointing because the fields have lacked a regular supply of freshwater while in West Africa where resource policy involving dams and flow regulation has contributed to wetland loss adversely affecting the farmers who utilize wetland via flood recession agriculture.

In a study done in uganda around Lake Kyoga it was found out that there is increased swamp reclamation for rice cultivation as opposed to earlier times when wetlands had been looked at as areas of little utility being used for animal grazing only (Mwaka; 1989). The study (Mwaka; 1989) outlines the major issues pertaining to the utilization of the Lake Kyoga wetlands noting that wetland reclamation has been facilitated by agricultural land shortage, market potential for the crops grown on adoptive population and the existence of some government owned rice irrigation schemes which have served as a model. Seasonal flooding, dying of swamps,

diseases, children not going to school, labour scarcity and lack of inputs are highlighted in the study as problems arising from continued sample reclamation. Although the study discusses the agricultural utility of wetlands, the study fails to incorporate the farmers needs created as a result of the unsustainable utilisation an important aspect which need to be considered in a conservation strategy. This study looked at this bit to bridge the gap.

In another cross-sectional study done on wetlands in drylands, it was found out that the use of wetlands has changed historically from animal grazing, vegetable fruit and water collection to increasing agricultural utilization (Scoons; 1992).

This practice is fuelled by increase in population and decline in rainfall. He notes that choices between investment in topland and bottomland areas is dependent on a variety of factors which include:- potential yield productivity, market value potential of different products, seasonal variation in labour requirements, availability of labour, gender division of tasks and risk perceptions of farmers. The study was confined in the wetlands of drylands, this study however intended to find out if similar factors will also hold for humid areas.

The uses to which wetlands can be put can be divided into four main categories: social, economic, cultural and ecological.

It is noted that although the physical wetland products may be directly or indirectly consumed, social and cultural

benefits cannot be readily quantified (Kareri; 1992). He contends that there were always useful resources that were drawn from the wetlands to satisfy social and cultural requirements of a community living near the wetland. He notes that among the sub-ethnic groups of the Luhyia community that practise circumcision the specific type of soil used was only found in some places in the wetlands. These sites were never allowed to dry up. Hunting of wild animals was also a popular social activity that could take place in the wetlands. Clay, a wetland product was used for plastering the walls and floors of houses. Vegetation from the wetlands have for long been used for construction of houses and granaries.

The Yala swamps and many others have been seen to be an important ecosystem for various species of birds and mammals. The swamps also act as filters for a variety of biocides and other agricultural pollutants from the catchment (Mavuti; 1989, Muthuri; 1992). The Lengurruahange swamps on the other hand are said to be very important as they allow various plant species and waterfall to thrive. The dense strips of forest along rivers protect the banks of a stream and prevents scouring and erosion during floods (Hughes; undated). She notes that the physical barrier of the forest prevents silt and sand from being washed into the watercourse. This helps to keep the stream flow fairly constant throughout the year.

Although various authors (Denny; 1990, Muthuri; 1989, Dugan; 1990, Mavuti; 1989, 1992, Hughes; undated, Kareri; 1992) explain the importance of wetlands; ecologically, economically, socially and culturally, they leave out an

important case of the link between the human community that lives near wetlands and the probable impact that the destruction of the environment would have on it, a gap this study intends to fill.

Livestock grazing in wetlands was and still is a common practice for many communities that live near the wetlands. It is noted that the pastoral system in Northern Sudan is being undermined through changing patterns of resource use while the intensive use of the Wadi grazing lands and competition with agriculturalists has resulted in environmental damage to the Wadi grazing (Scoons; 1992). It is also documented that the social control that ensured sustainable utilization of the wetland resources are slowly disintegrating (Kareri; 1992). Materials for making basket traps, chairs, cages and handcrafts were mostly obtained from the wetland vegetation which include papyrus reeds, bulrushes and other herbaceous vegetation, whereas honey collection for brews and medicine depended on the cheap availability of the local wetland materials. The above were a source of income. The social control of the sustainable wetland resource utilization was noted as slowly disintegrating hence diminishing.

The authors however do not explain how the social control was done and the impact of the social control disintegration has for the future of the resource hence the need for the conservation measures. The adoptive measures taken due to the diminishing resource were not highlighted as well. The study intended to fill these gaps.

The growing population which has resulted in land

scarcity is seen as the main force behind utilization of wetlands, while self sufficiency in food and improved living standards of the rural people are seen as the main reasons for increased government and donor. Support for irrigation and drainage (Olindo; 1985, Gichuki; 1992, Kareri; 1992). Although this trend continues few studies have focused on the environmental hazards that are precipitated by increasing wetland cultivation. This study intended to bridge this gap.

It is suggested by various authors such as (Dugan; 1990, Kerry; 1991) that continued wetland loss is as a result of the misuse, over-utilization, inadequate management and limited information on the values and dynamics of wetlands. It is also seen that due to the fact that most of the wetland values are public and not individual people tend to reclaim them for the individual gains rather than leaving them in their natural state. This being the case it would appear that unless a conservation strategy which has the local person at the base is found little can be done to safeguard wetlands on privately owned land. This study was designed to find out those socio-economic forces behind wetland cultivation and the impacts that arise in a bid to suggest a conservation strategy for the wetlands in the study area.

From the literature reviewed, it is shown that an attempt has been made to understand patterns of arable land use but of the reviewed literature little has been said about those socio-economic patterns that influence the increasing wetland encroachment. This study fills this knowledge gap by

identifying the socio-economic patterns that influence wetland loss in the study area since it is seen that the causes of the environmental degradation do depend on the socio-economic context of the population (O'riodat; 1971). The literature reviewed also shows that many wetlands not protected by the government and on private land are first being converted into agricultural use and therefore few are conserved as natural wetlands. Many authors including (Gaudet and Obeng; 1981, Denny; 1985, Muthuri; 1989, Gichuki; 1992, Mavuti; 1992) have considered the ecological impacts of wetland loss in isolation to the human communities who draw benefits from these wetlands or suffer due to their presence. This study intended to fill this gap.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction.

The purpose of the study was to investigate the changing wetland use and its environmental implications in Mumias division Kakamega District. This division was selected by the researcher as representative of those areas in Kenya experiencing serious wetland depletion. The study specifically:-

1) Investigated the changes in wetland acquisition, ownership and use with respect to wetland conservation.
2) Determined the socio-economic patterns influencing the use of wetland areas and
3) Showed how the process of increasing wetland encroachment

related to the environment by pinpointing the impacts that this practice had on the environment and the community.

Field data for this study were collected between January and March 1993 from a sample of wetland farmers in the study area. This period of sampling was chosen as it coincided with the peak of agricultural activities in the study area. Hence it was easier to locate wetland farmers for interview in their farms. For those not working in their farms then, an attempt was made to meet them in their homes.

3.2) Sample size and sampling technique

Four river valleys namely Nzoia, Lusumu, Sio and Lairi (Map. 1) were used in the study. These were selected because they were known to have had expansive wetland areas which are now diminishing. After identifying the river valleys, a systematic sampling procedure was designed and applied for the selection of sample wetland farmers from all those whose whole or part of their land borders any of the four rivers. The total length of the section of each of the rivers selected in the study area was calculated using the "Mumias topography sheet number 101/2 1970" (Map. 1). The lengths calculated for each river sections was then divided by 25, the number of farmers to be considered along each river to get the interval distance along the river of selecting a farmer for interview. These study points were then marked onto the map the researcher used during the field research to enable her

locate the points. At each study point the farmers found working in their farms were interviewed from the farms. Those absent an attempt was made to interview them from their homes and then later, after the interview they were requested to take the researcher to their wetland farms. In total 100 farmers were interviewed; 25 along each river.

3.3) Research instruments and their administration

To achieve the set objectives the researcher used the following instruments:-

a) Data on the historical development of the wetlands covering the evolution of wetland use and access, tenure systems and conservation strategies in the study area were collected through content analysis from a field of archival documents from the Kenya National Archives. The documents included:

1. North Nyanza annual reports;
2. Report of Committee on Native land tenure in the North Kavirondo Reserve;
3. African land settlement and utilisation, minutes of the ALDEV board 1952-58 and
4. Abaluhyia land law and customs.

The archival documents enabled the researcher to trace the trends in wetland acquisition, use, access and conservation strategies in the study area. At some stages in the course of studying the archival documents, it was found necessary to consult old members of the community for comparative information. The criterion for their selection was

age. Thus, only those who had lived in the area for 70 years and above were interviewed on the ownership uses and acquisition and conservation of the wetlands. The information acquired from this source, helped enrich the information got from the archives.

b) "Survey maps Mumias topography sheet 101/2 1970" was used for two main purposes;

i) getting the names of the river courses used in the study area; and

ii) calculating the lengths of the section of the river course in the Division so as to get the study points.

From the study area map and the scale given; River Nzoia course in the study area covers an approximate length of 33 kms. Of these only 18 kms were considered for study as the remaining 15 km are covered by the Nuclear Sugar cane estates of the Mumias Sugar Factory starting from the Nzoia bridge after "Shibale" shopping centre on the Mumias-Bungoma road northwards. River Sio (the section in the study area) covers an approximate length of 17 kms, Lairi covers an approximate length of 13 kms while Lusumu (taking the shorter tributary) covers an approximate length of 17.5 kms. The shorter tributary was used as this enabled the lengths considered for each of the rivers to vary less. Since Lairi was of comparatively shorter length, 4 kms were added by using the two sides of the river making the lengths of each river considered to be 17 kms, for Rivers Lairi and sio, 17.5 kms for River Lusumu and 18 kms for River Nzoia.

Dividing each of the length by 25, the length interval for study points was approximated to 0.7 kms (700 ms) for ease of estimation. Thus to select a wetland farm for study, the researcher had to walk 700 ms from one wetland farm to the next. The study points were translated onto the ground using the 1989 population census map for the Division. The river courses were considered in turns.

c) interview schedules: (Appendix I)

This was in form of a questionnaire. It was divided into three main parts. The first part dealt with wetland use and production, the second part looked at socio-economic background of the wetland user while the third part examined wetland ownership use and effects of the changing use. The questionnaire was administered by the researcher to a total of one hundred respondents. Those who could read and write were encouraged to write the answers to the questions by themselves while those who could neither read nor write were assisted by the researcher. In the latter case the researcher would interpret the questions to the respondent in vernacular for ease of understanding.

d) The repertory grid

The repertory grid technique was used to elicit data which would enable the researcher to identify personal environmental related problems that had resulted from wetland loss. The results from this technique were used to infer the likely environmental impacts that were created as people tried to satisfy these problems. This technique with its roots in clinical psychology represents an attempt to understand people

from their own perspective of the surrounding world (Francella and Banister; 1977). Thus the technique was designed to study personal environmental related problems resulting from wetland loss as perceived by the individual with minimum interference from the interviewer.

The basic assumption central to the repertory grid technique is that an individual organises the perceived world around a set of constructs. Each construct has two poles such as highly available to absent, very significant to not significant etc. The constructs although common to most humanity are personal in as much as they pertain to the individual in their relative significance, organization and particularly to their application (Naulikha, 1990:16). As a result of these differences then, one grades them with regard to the elements being used on the basis of cultural environment, experience and possibly character.

Elements define the field of grid and the constructs the distinctions among them. A repertory grid therefore represents the respondents system of personal constructs in which the columns of the matrix consist of the elements, stimuli, objects or things perceived, while the rows contain the constructs, ideas, or discriminants that are used to classify the elements being studied.

Prior to constructing the grid each individual visited during the pilot survey was asked to recall events from his or her own experience relating to wetlands before and after they were adversely interfered with. They were then asked to narrate briefly on each experience. They were to limit their

narration to resources, social and sporting aspects of wetlands within their locality. Each item of experience identified was noted by the researcher. These later formed the constructs of the grid during the field research and being taken to be problems that have resulted from wetland loss. The grid used in this study had one element which formed the field of the grid; significance of the problems resulting from wetland loss. The significance for each of the construct was rated by each of the respondent on a scale of 0 to 4 with the scale for each construct being defined (Appendix II).

3.4 Data analysis

Archival and other documentary data on the historical evolution of wetland use in the study area were analyzed, corroborated and presented qualitatively.

Data on the socio-economic background of the farmer was analyzed using frequency tables, chi-square and regression analysis.

The chi-square (x^2) was used to test for the association between the dependent variable which was the percent wetland cultivated (variable 2) and a given independent socioeconomic variable. The socioeconomic variables tested for association with percent wetland used were:

- Var 1 - Size of wetland.
- Var 3 - Farm size.
- Var 4 - Family size.
- Var 5 - Number of crops grown in the wetland.
- Var 6 - Wetland tenure system.

Var 7 - Level of education attained by the wetland farmer.

Var 8 - Length of time under cultivation (in years).

Var 9 - Purpose of wetland produce whether for subsistence or marketing.

Var 10 -Age of the wetland farmer.

Var 11 -Off-farm occupations.

The same variables were tested for a linear relationship between each of them and the dependent variable in the regression analysis. In all cases, variable 2 was treated as the dependent variable while the selected socio-economic variable was the independent variable. The significance of the R-values obtained were tested using the F-test at 0.05 level of confidence. Generally a large computed value at the described degrees of freedom which is more than the tabled F-value for the same degrees of freedom at the confidence level determined beforehand, shows that R-value obtained is statistically significant and that a linear relationship between the two exists at that confidence level. The chi-square and regression analyses were thus used to test hypothesis number one (section 1.4).

Data on the patterns of inter-dependence among the socio-economic variables were analyzed using Factor analysis technique. The technique is a means by which the regularity and order in a phenomenon can be discerned. The analysis divides observations of variables into distinctive patterns of occurrence in addition to reducing a large data set to a small number of factors which can be characterised and explained.

The most common applications of the technique can be classified into three major uses:

a) identifying groups of intercorrelations ; this is an exploratory function of the technique geared towards detecting and identifying groups of interrelated variables.

b) confirmatory use; which involves the testing of hypothesis about the structuring of variables in terms of the expected number of significant factors and factor loadings, and

c) Measuring device which involves the production of new combinations of the original data set which may be used as new variables for further analysis.

The first two uses are applicable to the present study. SPSS programme was used to generate factor analysis results for this study. The procedure basically involves:

a) Preparation of a correlation matrix. The study adopted R-mode factoring which involves the use of information measuring correlations among different variables for a group of observations.

b) Extraction of initial factors: this involves the exploration of possible data reduction involving the construction of a new set of variables which are based on interrelationships in the correlation matrix. In this step there are two basic approaches, Factor analysis and Principal component analysis. This study adopted the former.

c) Varimax rotation: The aim of this is to maximize

variance in the cosines. It is usually done in the search for simple and interpretable factors. The rotation ensures that each factor is orthogonal (hence uncorrelated) to each other.

The factor analysis model used in the study is given as

$Z = {}_{j1}F_1 + a_{j2}F_2 + a_{jm}F_m + d_jU_j$ where

Z_j = Variable in standard form

F_1 = hypothetical factor

U_j = unique factor for variable j

a_{j1} = Standardized multiple regression coefficient of variable j on factor 1 (factor loading)

d_j = Standardized regression coefficient of variable j on unique factor j.

The major factors that were looked for in this analysis for aiding the interpretation of the results included :

a) Eigen values; These are the squared factor loadings which represent the total variance accounted for by a factor. This value is designated as h (lambda).

b) Communality: This stands for the total variance of a variable accounted for by the combination of all common factors. It is designated as h^2 and given as

$h^2 = a^2_{11} + a^2_{12} + a^2_{13} + \ldots\ldots + a^2_n$.

where :

h^2 = communality

a^2 = squared loading of variable 1 on factor 1

c) Uniqueness: This indicates the degree to which a variable is unrelated to others (the extent that the data on a variable cannot be derived or predicted from

the data on the other variables). By subtracting the percentage of variation in common (communality) from 100, the uniqueness is determined.

For this study, eigen values were used for the decision on the cut-off point in which the significant factors were selected. In this case two factors out of the total 5 factors that were extracted were found significant as they had eigen values of 1.922 and 0.96. The others had low eigen values hence were considered insignificant. These two factors were then rotated using the varimax rotation which yielded two uncorrelated factors. After this step, the next task was the interpretation and the naming of the derived factors. The influence of the variable within each factor as well as the strength of their loadings were considered. The explanation of the results is presented in section 4.5 of chapter 4.

Data on the availability of natural wetland resources was analyzed using the repertory grid responses. The total score for each construct was calculated by adding all the individual responses for each construct (Appendix II). The number of responses for the same construct was also sort (some respondents would leave some constructs unanswered or would give an "I do not know" answer). This number (N) was multiplied by 4 (the maximum value for each response) to get the maximum score. The total score was divided by the maximum score and multiplied by 100 percent to get the percentage for ease of comparison. This was done for each construct in the grid. The

constructs were then ranked on the basis of the percentage value in order of importance.

CHAPTER FOUR:

RESEARCH FINDINGS AND INTERPRETATION.

4.0 Introduction.

This chapter highlights trends in wetland acquisition, ownership and use in the study area. It also examines the present status of wetlands highlighting associations between wetland cultivation and selected socio-economic factors which are influencing increase in wetland cultivation. This is followed by an examination of the results from the repertory grid.

4.1 Wetland acquisition, ownership and use during the pre-colonial era.

The Wanga as a group acquired land either as first occupants of uninhabited land or by conquest. Purchase or payments to other tribes for surrender of previously existing land rights were non existent. They established a home wherever they found room and could hold out against enemies and so extended their land holdings according to their population size and its ability to defend itself. Once acquired, boundaries were established. Boundary demarcations were rivers, continuous ridges, valleys, forests or an acknowledged stretch of no man's land. Within each settlement village, the elders surveyed the land and scheduled out its

use in terms of where to build homesteads, establish farms and public utility areas.

The public utility areas were classes of land specially set aside and which had facilities for communal use eg pastures, salt licks, water points, wells, bush land or uncultivated and forest for the extraction of construction materials, bush foods, medicinal herbs and firewood. This was the property of the sub-tribe as a whole and no occupation rights could be acquired therein without the consent of the chief and the tribe.

On the basis of land ownership, land among the Wanga was categorized into four main types:- family land, no man's land or empty land between distant clans, communal land and individual land. Family land comprised of land that the holder inherited as a whole or part of grandfather's or father's land and any other land inherited as the family property.

Communal land, a public utility area, had resources such as pastures, uninhabited bushes, forests, salt licks and water points. Wetlands, the main focus of this study can be categorized under communal land. Some areas of the communal land were treated as relief land. The pastures belonged to the entire community with each village having its own pastures under the administration and trusteeship of the "Liguru". The Liguru was a neighbourhood elder whose function was to keep peace, to protect the land and its occupants and to settle any disputes which could arise. The Liguru ensured that no cultivation encroached on the pastures. Every clansman had a

right to graze his livestock in the pastures as long as he adhered to the rules and regulations governing the proper use and conservation of the pastures. No person was to enclose or cultivate an "ekewa" or "isa" which were subclan lands that were always marsh lands adjoining streams.
This provided pastures and other resources to the community (Abaluhyia land law and customs). No person was allowed to cut down trees from the common grazing lands without the permission of the Liguru while there was no restriction on cutting down very small trees for building and grass for thatching.

The uncultivated bushes formed a critical food reserve of wild fruits, vegetables, edible leaves and wild game. This food reserve was very necessary as it helped many families facing food shortages. It was also in the wetlands especially in the marshes that children of a village would be found playing. Salt licks were collectively used by all stock owners in the vicinity without any restriction. The Liguru was responsible for them. If a man dug some salt lick for his cattle, nobody else was permitted to take his cattle to the it until after the man's cattle had consumed it all. Areas having clay for pottery were limited and although each area had its owner, there was no restriction in its use by persons whose occupation was pottery. Such people obtained the clay free of charge.

Wild trees or forests were a public utility resource since they were the main sources of woodfuel. All forests were under the chief with the exception of the forests near

the ridges which were controlled by the Liguru. Trees could not be cut from these forests without his permission. Only small trees could be cut down for building purposes without either the permission of the chief or the Liguru. Thus these resources were open to all but were protected by law. The relief lands were used by the villagers to boost production during the second farming season of the year especially if the first season was hit by drought or other calamities. In essence, the public utility land which include the wetlands, was a critical ecological reserve of extra land for agricultural production, building timber, grass for thatching raw materials for handcrafts such as pottery, basketry and for making fish traps, a rich source of wild fruits and animal food, water and salt licks among other resources.

The "Liguru" or the council of elders had powers to deny any individuals the right of using such resources if there were sufficient grounds of doing so. A villager who misused such resources or abused the utility directives from the elders and engaged in activities that threatened the resources lost his rights to these resources (KNA : DC/EN 3/3/2). The individual's right to resources in public utility areas include rights to rivers and springs. The care and maintenance of a river was the responsibility of the man who resided in the proximity. It was his responsibility to see that customary laws relating to rivers were kept and obeyed. Among the offenses that called for punitive measures to be taken against offenders included polluting the water by excreting or urinating in it and throwing of dead animals on

banks of rivers. Any person who did this was ordered to remove and bury them. Any person who suffered from infectious disease such as leprosy was not permitted to bathe in the river. Punitive measures against offenders included suspending his rights to the river or spring.

The zonation of wetland resources followed a patterned organizational system that ensured their protection and maintenance . Fencing off salt licks or fertile swampy pastures was illegal as such resources were for communal uses. Certain tree species found growing along the river banks would not be cut by anyone except with permission from the council of elders. They knew that by so doing the river volume would be affected.

4.1.2 Rationality of wetland use systems and wetland conservation in pre-colonial era.

The pre-colonial Wanga wetland use systems were based on the ecological characteristics of the wetland which were designed to meet the varying needs of the community. Under circumstance of plentiful land, sparse population and subsistence as an overriding objective, the community viewed communal ownership of wetlands as the best possible tenure system. Under this system, the wetland resources were harvested sustainably because there were clear cut rules that governed both users and enforcers. The system of the pre-colonial Wanga use rights to the wetland resources was part of a broader natural resource management system which would help spread risks. It was also an important source of

conserving the wetlands and to a degree of manipulating through management of the biodiversity that exists in wetlands.

As mixed farmers the choice of wetland use strategies was mainly based on an intimate knowledge of rainfall, different qualities of soils and the characteristics of indigenous vegetation in the wetlands. The nature of the environment in the wetlands determined where to graze and where to get the various handicraft materials. They knew that certain areas in the river valleys had fertile moist alluvial soils which would be suitable for growing indigenous crops like sorghum and finger millet. These areas thus, acted as dry season fall back areas. The waterlogged soils existing in the marshes and swamps were not suitable for agriculture or grazing but the vegetation therein could be utilized for other uses.

The community had evolved a well managed and basically sound ecological strategies. This enabled them to utilize the wetland resources on a sustainable basis. They exploited different niches in the wetlands (reeds, forage, alluvial soils, pot clay, salt licks e.t.c.). The wetland use systems made best use of the wetland vegetation, soil and water through a system of wet and dry season grazing, resource harvesting for different handicrafts combined with dry season food crop growing reserves.

They had a well developed knowledge of the wetland vegetation and its uses. Their knowledge reflected their lifestyles and the extent of their dependence on the wetland

ecosystem including which species to use for dry wood, wood fuel, building timber for houses, building material, for granaries, food for livestock, food for people, veterinary medicine, human medicine, water purification and ceremonial purposes. They also knew sites within the wetlands where they would get various materials for their handicrafts.

The community in utilizing the wetland resources showed rational and sustainable management strategies:

a) by utilizing the drier land reserves in the wetland during the dry season for food crop procurement and by using the grass reserves in the wetland during the dry season, this gave the land more time to build up fertility while it gave the grass and ground cover time to recover during the wet seasons. This helped them to spread risks and retain wetland resilience.

b) by not cutting large or important trees such as "omurembe" (Erythrina abysinica), a ceremonial tree, (field research) they could harvest wild fruits and other products which did not involve destructive clearing of riverine trees. The dead woods were used for cooking while smaller tree species were used for building. This ensured continuity of the reserves hence maintaining biodiversity.

c) by drawing from the wetland what you needed; that is: water, grass, reeds or fuel wood e.t.c. ensured that access to wetland resources was specific the to function which minimized degradation and abuse of wetland resources. This ensured that the capacity and ecology of

the wetland continued beyond their age.

d) by protecting the wetland resources communally and individually, an individual was conscious of his/her actions so that the resources would be used sustainably. You drew from the wetland ecosystem what was just enough for your needs not wants.

The "Liguru"and the council of elders were to oversee that they are used in the right manner while their abuse was followed by punitive measures. An individual had both limited and unlimited accessibility rights to wetland resources depending on his membership status in the clan or village and his overall social conduct.

4.2 Wetland acquisition, ownership and use during colonial and post-colonial period.

The colonial period in Wanga started in 1894 (Report of Committee on Native Land Tenure in the north kavirondo reserve). The establishment of the colonial rule had important implications for the pre-colonial institutions in Wanga. The new rulers set up new administrative procedures that displaced the old one based on elders. In 1902 the then North Kavirondo district was curved off from Uganda and added to the Kenya colony protectorate (Were; 1967). From then on, the British started appointing chiefs and headmen hence changing the customary practice of appointing elders to the offices "Liguru" and council of elders. These changes led to far reaching effects in land administration in the study area.

The system of acquiring land at the community level was

abolished and land now had to be acquired at individual level. As a result, from 1912, there were no empty lands for the community to acquire freely. There were instances where an individual could obtain rights of ownership of land next to wetlands on conditions that he should have cultivated it for two decades (KNA : Abaluhyia land law and customs). Thus for the first time, the wetland became individually owned and not under communal land during the pre-colonial period.

This step of individualising wetlands implied the principle of exclusion from wetlands as opposed to customary law of communal ownership which lay a greater emphasis on inclusion through communal access and usage. In general, the change in tenure system affected:-

a) Rights to wetland resources, their protection, usage and management, all these were to depend on the wetland owner hence reducing the customary management arrangements.

b) Wetland usage; the owner was to deliberate on what kind of use to put his wetland to.

During this colonial period, although land was inherited by the sons of a man along same procedures as those in the pre-colonial period, the value of land was however changed from the old use value to the combined market and use value (Esese; 1990). The new market value made land including the wetlands to change ownership more frequently than in the pre-colonial period. By 1935, the communal lands which included the wetlands were being surveyed and registered as individual land. By 1940, due to increasing pressure on land,

if a son had missed land allocation by his father for one reason or the other, then one had to apply for land to the headman or chief of his village who in turn forwarded the application to the District Commissioner (D.C.). It was the D.C. to allot him land where he (the D.C.) felt land was available for the applicant irrespective of the nature of the land. In these circumstances it was possible that one would be given land which enclosed or bordering a wetland. These trends led to an increase in use of wetlands as more people began tilling land bordering the wetlands. The practice infringed on the public use of wetlands although it availed more land to the people.

Although the wetlands were individualised, they were less utilised as they were hard to till until the coming of the ox-ploughs in 1930 (Esese; 1990). These were introduced by a small number of farmers who could afford. The invention enabled many farmers to encroach more on their wetlands by cultivating them. The main crop grown then was rice. This practice was later abandoned due to scarcity of plough oxen strong enough to till the heavy wet soils, the vulnerability of the crop to hailstorm and shortage of family labour to protect the maturing rice crop from birds among other reasons. Those who did not get access to ox-plough continued to handtill small portions of their wetland.

During the decade of 1955 to 1965 sisal and coffee were introduced as cash crops but neither of them succeeded in establishing itself (Barclay; 1977). Sugar cane was introduced but on a small scale for "jaggery" milling brown sugar. This

did not last long. It was around this time that sugar cane for white sugar was grown by a few farmers to act as demonstration farms. Till then, the agrarian economy in the study area was stagnant as farmers produced only subsistence crops. It was in the light of this that the Mumias Sugar Company (MSC) was established sponsored by the Kenya government and managed by Booker McConell, a London based multinational cooperation. The factory began milling sugar in July 1973. The introduction of new agro-industry appeared to be a means of generating economic take off for the relatively poor and backward Wanga locations of Mumias Division, Kakamega District (Barclay; 1977 : 59).

The establishment of the sugar industry had several implications to the wetlands in the study area:

a) The sugar factory is situated along Nzoia river with the nuclear estate farms occupying the wetland areas in that locality.

b) During the establishment of the factory many people were made to move from the factory site to purchase land from other areas. In cases where the wetlands were purchased, there were changes in use as the purchaser tended to convert them to arable land.

c) The massive enlistment of several thousands of out-growers to plant cane on a contract basis meant that the area under arable land be extended. In some cases, this extension involved the wetlands.

d) Originally it was a requirement that a farmer leaves one hectare (2.47 acres) free for other crops.

Although some farmers tended to adhere to this, with the increase in population and hence land pressure, many have tended to let the 2.47 acres or less to be in the wetlands leaving the well drained land for sugar cane growing and the wetlands for food crop production.

Intensive cultivation of sugar cane in the study area has in essence created a situation in which crop production has been reduced considerably. This in effect has necessitated the development of the badly drained lands aided by government to alleviate the precarious food situation.

The foregoing analyses shows how the physical, economic and political factors have influenced wetland resource utilization in the study area.

In the pre-colonial era the wetland were communally owned. The system was sustainable in the sense that it catered for every body's needs and retained the resilience of wetlands. They were individually and communally protected under the headship of the "Liguru" and the council of elders.

The colonial era was characterized by individualization of wetlands and an overemphasis on agricultural production ignoring the many other uses that the wetlands are endowed with. The wetlands were opened up more for cultivation by the introduction of ox-ploughs for those that could afford. This was done for rice production. It was during the same era that cash crops like sisal and coffee were introduced in the study area. This may not have had a greater impact on the

wetlands apart from extending the land under cultivation for those who had smaller land, this could have made them encroach on the wetlands. The introduction of cane sugar for the production of white sugar initiated greater changes on wetland ownership and use. First, the factory and the nuclear estate farms are located in the once wetland areas along river Nzoia. Secondly, some people evicted from the factory site ended up purchasing wetlands hence changing them to food crop cultivation and third, the introduction of the out-grower department meant that arable land be extended therefore encroaching on the wetlands or the cultivation of the drier land for sugar cane while leaving the wetlands for food crop cultivation.

All these changes in wetland acquisition, ownership and use in the study area have in essence let to:

a) a reduction in size of the natural wetlands;
b) the conversion of natural wetlands to arable land with a network of drain that drain water during the wet seasons;
c) resulted in over-exploitation of limited wetland resources; and
d) an erosion of communal arrangements that protected the wetlands and wetland resources.

In effect this section sets the background for the discussion of the present status of wetlands in the study area, socio-economic factors influencing wetland loss and the environmental impacts created as a result of wetland cultivation.

4.3 Status and profile of wetland resource in the study area.

This section intends to ascertain the conclusions reached in the previous section in addition to considering the socioeconomic context of the wetland farmers using the responses from the questionnaire.

An attempt was made to collect information about peoples' views concerning the state and cause of wetland removal. The respondents were required to comment about the extend of wetlands in their locality. Along with each response given, the farmer was required to give reasons for the answers given (Appendix 1, part 3 questions 1-2). The responses enabled the researcher to categorise them into two parts. Those that held the views that the wetlands are currently of the same extend as they were in the past and those that viewed the existing wetlands as having reduced in extend. A possible explanation for the former view would be conservation / preservation of the wetlands while for the later would be excessive wetland removal in search of land for cultivation, settlement as well as wood fuel. Indeed the response was reflected by all the respondents as none indicated that the area has remained the same as shown in Table 4.1.

Table 4.1 Views about the extend of wetlands.

Category of response	Percentage
Area remainened the same	0
Area decreased	100
Total	100

Source : Field data.

Although wood fuel was cited as one of the reasons for wetland removal, the major reason given was search for land for cultivation. This implies that people would not clear the wetlands for wood fuel perse, but would pick these from the fallen trees which were cleared to give way for cultivation and settlement.

To be able to compare the rate of wetland removal at present and a period of 20 years ago (before 1973 and present 1993), the respondents were provided with alternatives to tick in form of a likart scale also called the rating scale as it enables people to rate objects or events according to their liking (Kerich; 1990). The responses obtained were categorized and the results compared. The question designed to elicit the responses of the farmers about the rate of removal is included in appendix 1 part iii question 3. The scale used included the following possible responses: very low, low, moderate, high and very high. The responses of each subject was categorized depending on its position in the scale. To obtain a more generalized and acceptable view, for any one period of time, responses for all the 100 farmers interviewed were used. Taking the number of responses in any one category to be X then percentage value (p_v) for each category would be $X/N^{x100\%}$ where N was the total number of people interviewed. The results are shown in table 4.2.

Table 4.2 Rate of wetland removal.

Period	20 yrs ago		Present	
Category of response	Number of responses	Percentage	Number of responses	Percentage
Very low	60	60	1	01
Low	21	21	2	02
Moderate	18	18	5	05
High	1	01	30	30
Very high	0	00	62	62
Total	100	100	100	100

Source: field data.

Since internal differences were noted as to how low is very low and how high is very high, for the purposes of comparison, it was necessary to categorise the opinions into two main categories. Thus responses very low, low and moderate constituted low while high and very high constituted high. From this categorization, the percentage of those who regard wetland removal in the past as low were (60 + 21 + 18) being 99 percent with only 1 percent considering it high while those who regard wetland removal at preset as low were (01 + 02 + 05) being 8 percent while 92 percent consider it as high at present.

There are several factors that can influence ones views concerning the rate of wetland removal, one of them being age. An individual in the age group of 18 - 29 may not see any great difference between wetland removal at the past (over 20 years ago) and present. The 01 percent who viewed wetland

removal in the past as high were in the age set (18 - 29). Another factor that could influence ones views is size of the farm and size of the wetland that one owns. If one's farm or wetland is larger in size than his family can till, he may not see the rate of wetland removal as being high. The 8 percent who viewed wetland removal at present as low were people with large farms whose wetlands are yet to be encroached on excessively. On the whole, it can be concluded from the percentages that people view wetland removal in the past as low having been conserved for the purposes of drawing wetland resources while it is high today as more people drain them and clear the trees therein hence destroying the wetland ecosystem.

The perception and traditional attachment to the wetland and hence the conservation ethic of wetland was reflected by the way people responded to questions related to wetland plant and animal species and their uses. The questions asked the subjects to indicate how the wetlands were used in the past and at present. They were also asked to name some of the plant and animal species whose habitats were the wetlands and their main uses. Together with these, they were asked to name some plant and animal species that were prohibited from careless destruction (appendix 1 part 3 question 4 and 5). The responses to these questions reflected the way people made use of the wetlands and their basic beliefs about them hence inculcating a conservation ethic of the wetlands. Table 4.3 shows some of the plant and animal species in the wetlands in the study area and

their uses.

Table 4.3 Sample of wetland plants and their traditional uses in Mumias.

Family	Scientific name	Luhyia name	Use
Euphorbiaceae	Bridelia micrantha	Eminyerenyen-de	Timber, water conservation, fuel wood.
Palmae	Phoenix reclinata	Amashindu	Basketry, ceremonial.
Cyperaceae	Cyperus papyrus	Amaturu	Making mats
Cyperaceae	Cyperus sp.	Lise	Making traditional salt
Graminae	Pragmites mauritianus	Eshisari	Making fish traps, thatching.
Graminae	Leudetia kagerensis	Obweywe	thatch material

Source: Field data.

Plant specimens were collected and identified at the East African Herbarium, Nairobi.

From the table, it is seen that wetland vegetation played key roles to the community in:

a) provision of raw materials for fish traps, basketry and mat making among others;

b) provision of thatching and construction materials;

c) provision of forage;

d) provision of food;

e) provision of ceremonial plant species;

f) provision of fuel wood;

g) conserving river water volume;

h) provision of medicinal plants.

In showing how the wetlands were used in the past and at present, they indicated that whereas different vegetation species had differing uses, the water in the wetlands was used both for livestock drinking and domestic use. The soil was used for salt licks where it occurred, it was also used for pottery depending on its suitability and for circumcision ceremonies. In essence, since these functions and values of wetlands were to be sustained, hence wetlands received protection. At present wetland uses have changed from the traditional ones to become arable land for cultivation. Although the main push factor has been the need for more land for cultivation it can also be argued that some of the traditional uses of wetlands have lost value at present hence the destruction of the ecosystem.

Incidentally all wetland plants were not to be carelessly destroyed. There were however certain tree species that would not be cut unless the elders sanction for such , among these were "Omurembe" (Erythrina abysinica) which was a ceremonial tree.

Wetland utilisation at present.

For each of the farmer visited, it was indicated that at least one, two or all of the features that characterised the operational wetland (marsh, swamp, riverine forest) exist or existed on their farms at one time or the other. The present state of fewer wetlands in the area thus

implies a greater encroachment by the people on unsustainable basis. Wetland acquisition at present is in three modes: by inheritance, purchase or by hire. Seventy seven percent (77 %) of the respondents inherited their wetlands, twenty one percent (21 %) bought while two percent (2 %) had hired. The high percentage of those who had inherited their wetlands shows how prevalent this tradition of land inheritance is in this community. Although acquisition of land by inheritance gives the owner a sense of stewardship it also encourages land fragmentation which may not be very profitable for mechanised farming nor large scale production as the farms diminish in size with time. This may also have a negative implication to wetland conservation; one is likely to conserve if the size of his wetland is big enough. Wetland fragmentation could also lead to wetland exhaustion since the small wetlands may not be given time to recover.

The fact that 21 percent of wetland owners purchased their wetland shows a changing trend on wetland acquisition and use. Wetlands have changed from the use value which was maintained during the pre-colonial times to the combined market and use value where the wetland is seen not only as a commodity of production but also for economic gains by sale of the wetlands. Having been bought, it would mean more intensive utilization.

The smaller percentage of those renting the wetlands could be explained in two ways:

a) People not willing to rent out their wetlands as they

are the only production land units remaining or;

b) The unwillingness of people to hire land in the wetlands as the labour inputs involved are more than the returns within the given time of hire.

The farm sizes for the sample set are shown in Table 4.4.

Table 4.4: Farm size (acres)

Acres	Percentage
1-5	31
6-10	31
11-15	18
16-20	11
21-25	4
26-30	1
31-35	1
36-40	2
Missing	1
Total	100

Mean: 8.995; Maximum: 40.000;

Mode: 2.000; Range : 39.000.

Source: Field data.

The table shows the mean farm sizes for the sample set was 8.995 acres while the mode was 2.000 acres. The range however was 39.000 hectares. These statistics reveal a disparity in farm sizes with the majority of farmers having two acres. This, as compared to the maximum number of acres held by some farmers of forty acres give a large range of thirty nine acres. This disparity in farm sizes would influence wetland use differently when other factors are held constant. The proportion of wetland cultivated may be

influenced by the farm size that one has. Farm sizes may also affect the extend of specialization where those with smaller sizes may not specialize in the growing of a particular crop nor of preserving his wetland.

The size of wetland that a farmer has was also computed. The results are shown in table 4.5.

Table 4.5: Size of wetlands.

Acres	percentage
1 - 5	81
6 - 10	9
11 -15	6
16 - 20	3
21 - 25	0
26 - 30	1
Total	100

Mean: 4.58; Maximum: 30.00;
Mode: 2.00; Range : 29.00.
Source: Field data.

The table shows sizes of wetland owned by the farmers in the sample set. The mean size is 4.58 acres. The majority of the farmers have two acres thus occurring in the set of 1-5 acres, a group in which 81 percent of the wetland sizes belong. The size of wetland that a farmer has may influence conservation of the wetland ecosystem. Those with many acres of wetland would tend to cultivate few acres living others under natural state. Those with few acres tend to subdivide them further with little or no preservation of the wetland.

Table 4.6 shows the percentage of wetland cultivated by each of the farmer interviewed. The mean percentage of wetland cultivated was 66.15 percent. This implies that a mean of 33.85 is preserved as natural wetland. The mode of 100 percent implies that the majority of the farmers have cultivated the whole of their wetlands. This points to the fact that many of the wetlands in the study area are threatened with disappearance due to agricultural encroachment. The rate at which this disappearance is taking place is however varied as shown by the variances in the table.

Table 4.6: Percentage of wetland cultivated.

Percentage cultivated	Percentage
0 - 20	7
21 - 40	12
41 - 60	24
61 - 80	24
81 - 100	33
Total	100

Mean: 66.15%; Maximum: 100.00%;
Mode: 100.00%; Range: 99.
Variance: 844.412.
Source: Field data.

Family sizes of the wetland farmers was computed as well. Mean family size was 7.52 while the majority of those interviewed had family sizes of seven people. It has been argued that where the number of family size is high, more resources will be devoted to food production (Obara; 1983). If this holds,then as it relates to the problem of the study

it will appear that this will be done at the expense of wetland preservation; more wetlands are turned into land for food crop production while less is preserved as natural wetlands. The mean family size of 7.52 characterised with the extended family system creates heavy dependency ratio and insatiable subsistence demands. This creates more demands on wetlands. The large number of family sizes may also imply increased wetland subdivision to provide land for the sons. However this study does not specifically examine the role of gender in wetland utilization and as such, this may be an area for further research.

Table 4.7: Family sizes.

Number	Percentage
1 - 5	21
6 - 10	56
11 - 15	16
16 - 20	5
21 - 30	2
Total	100

Mean: 7.52; Maximum: 29.00;
Mode: 7.00 Range: 27.00.
Source: Field data.

Length of time that the wetland has been farmed was also examined. The results are shown in table 4.8.

Table 4.8: Length of time under utilization.

Years	Percentage
0	7
1 - 5	36
6 - 10	22
11 - 15	13
16 - 20	17
21 - 25	0
26 - 30	2
31 - 35	1
36 - 40	2
Total	100

Mean: 9.747 years; Maximum: 40 years;
Mode: 2 years; Range: 40 years.
Source: Field data.

The average number of years that the wetlands in the study area and for the study sample have been in use is 9.747 (approximately 10 years). This means that on the average wetlands in the study sample were converted to agricultural lands around 1983. The trend however started much earlier about 40 years ago (around 1953). This was however at a very low rate. Indeed only 2 percent (Table 4.8). Many people, however, have used wetlands for a period of only 2 years (in the class of 1- 5, table 4.8). This period is quite recent implying that many more people are getting into the practice hence converting more wetlands to agricultural fields. This could be due to increasing population and land pressure. It is worth noting that 7 percent of those interviewed have their wetlands intact as natural wetlands. It could be argued that for

people feed on. Indigenous crops such as finger millet and millet are not as popular. This may have adverse effect on crop diversity which may have far reaching consequences to the food security of the area. Although sugar cane is grown by all farmers visited, only one person had it in the wetlands. This shows that for most people sugar cane is grown in the well drained uplands soils leaving the marshes and swamps for food crops.

It was also observed that the tree popular in the wetland in the study area was Eucalyptus spp. This shows that the indigenous wetland tree species are being replaced by an exotic species which may have adverse effects as well. The popularity of this tree species can be attributed to the fact that the tree being fast at maturing, with a very high water uptake helps the farmers to drain the water off the marshes alongside providing income by way of timber and firewood sells.

Farmers were given a scale to rate the reasons that have led them to resort to the use of wetlands for cultivation (Appendix I part I No. 8).The total score was obtained by adding the individual responses while maximum score was obtained by multiplying the number of respondents who were 93 (those who had cultivated part or whole of their wetland) by 4. The distribution of the responses are shown in Table 4.10

Table 4.10: Reasons for use of wetlands.

Reason	Score	Max. Score	Score as percentage of max.	Rank
Lack of enough land	346	372	93	1
Distribute risks	175	372	47	2
Crops grown	127	372	34	3
Financial gains	118	372	31	4
Easy to manage	110	372	29	5
Persuasion by extension officers	98	372	26	6

N = 93;
Source: Field work 1993.

In order of significance, table 4.10 shows that the majority of the wetland farmers resort to the cultivation of wetlands due to lack of enough land. This spells out the arable farming orientation of the people in the agricultural enterprise production, despite the difficulties involved in the working of wetlands as implied by rank 5. Thus non-economic factors (rank 1, 2 and 3) exert a strong influence on the use of wetlands for crop production. The farmers' concern for utilizing the wetlands for crop production parse, take precedence over economic considerations in the wetland utilization. In addition, the security of subsistence (as implied by rank 2) is a vital consideration. Thus the subsistence requirements of the farm families are an important factor influencing the

changing use of wetlands.

The economic factor (rank 4) exert a fairly strong though indirect influence on the farmers use of wetlands. However, the influence of this factor is not wholly economic as it has its roots in the farmers' social obligations. Consequently, despite the potential for commercial agricultural production in the wetlands, this is yet to be propelled by strong economic motives. This will probably be made stronger by the use of extension officers whose presence has either not been felt or is not widespread.

The farmers complained of disturbance from wild animals such as monkeys and baboons which inhabit the remnant thickets left by afew farmers along the rivers. Therefore, in a bid to reduce their disturbance many of these remaining thickets will be cleared. Hippopotamus were cited as a perennial problem to the crops especially when the rivers Nzoia and Lusumu flood. Wetland birds that seasonally visit wetlands such as cranes and king fishers destroy crops as well. The seed eating birds such as the weaver birds were said to be on the increase. All these can be explained in the light of decreasing natural wetland habitat and an increasing agricultural ecosystem in the wetlands. As a result of these, the wetland wildlife are displaced hence destroy crops grown. The introduction of crops in the wetlands on the other hand has introduced more pests which feed on the crops grown.

4.4. Socio-economic influences on the use of wetlands in the study area.

The purpose of this section is to give an insight into the association between farmers' socio-economic characteristics and the percentage of the wetland cultivation. Thus the hypothesis, socio-economic characteristics of a farmer influence on the percentage of wetland cultivated is examined. The socio-economic variables selected for the Chi-square (X^2) and regression analyses are shown in section 3.4 of chapter three.

4.4.1. Results of the Chi-square test.

The primary objective of using this statistic was to determine whether a systematic association occurs between the variable under test and variable 2 (percentage of wetland cultivation). Basically, a large computed Chi-square (X^2) value is compared to the tabled chi-square value with the same degrees of freedom implies that an association of some kind exists at the particular confidence limit. On this basis, it can then be established whether the variables under study are independent of one another or are related.

Table 4.11 shows the Chi-square relationship between the percentage of wetland cultivated and selected socioeconomic variables.

Table 4.11: Significant Chi-square relationships between the percentage of wetland cultivated (var 2) and the selected socio-economic variables.

Var. No	Var. name	N	df	Comp-uted X2	Crit. X2 at 95%	Sigf. at 0.05	Sigf. at 0.01
1	Size of wtl.	100	16	19.9283	26.5	-	-
3	Farm size	98	28	26.0116	41.3	-	-
4	Family size	100	16	15.1057	26.5	-	-
5	No. of crops grown	92	12	6.0930	21.0	-	-
6	Wtl. tenure system	100	8	3.7381	15.05	-	-
7	Level of edn.	99	8	1.0253	15.5	-	-
8	Time used	98	28	116.1522	41.3	*	*
9	Purp. for the prdc.	92	6	5.7417	12.6	-	-
10	Age of wtl. user	100	16	17.3541	26.5	-	-
11	Off farm ocpn	99	4	0.6585	9.49	-	-

- represents lack of significant relationship at either 0.05 or 0.01 level of confidence

* represents presence of significant relationship at either 0.05 or 0.01 level of confidence.

Source: Fieldwork.

Length of time within which the wetland had been under cultivation was associated with the percentage of wetland cultivated at both 0.05 and 0.01 levels. This can be explained in three major ways. First, a farmer cultivating his wetland, the size cultivated would depend on several other factors including farm tools at his disposal and the labour involved. As he cultivates he may add more acreage as he would already be having the farm tools and would have estimated so as to know the kind of labour required. Secondly, as one tills his wetland, with time the amount of land cultivated will be a function of the previous amount especially so if he wants to increase the produce. Third, the acreage of wetland cultivated also seem to increase with time due to wetland fragmentation. The wetland are continually being fragmented to be distributed out thus the parts not yet involved in cultivation will continually get involved as the wetland is fragmented with time.

The lack of relationship between the other selected socio-economic variables and the percentage wetland cultivated is a manifestation of the complexity of decision making process about the size of wetland to be cultivated. It shows that those variables lacking a relationship contribute (as independent variables) meagrely to the understanding of the process with regard to how much of the wetland should be cultivated. The process incorporates many factors than the selected ones, this can be another area for further research.

4.4.2. Results of the regression analysis.

The results of linear regression analysis are shown in Table 4.12. It shows the constant, coefficient, R-square, F- computed and F-tabled for each of the variables tested. The F-test was used to show the significance of goodness of fit between the dependent and the independent variables. From the table, it shows that family size with R-squared of 0.0498 and a computed F value of 5.13 as compared to the tabled value of 3.92 significantly influences the percent of wetland cultivated. The relationship however accounts for only 4.98 percent of the total variation observed in the dependent variable showing that its linear contribution is meagre. The positive coefficient of 0.292 shows the presence of a positive relationship.

The conversion of a family's well drained land property into cash crop growing involved some liquidity, for which most families were inadequately prepared. Apart from that, the introduction of the new crop (sugar cane) involved some degree of competition with the food crops for better soils where latter are relegated to the wetlands, These two factors combined, tend to weigh more on large families characterised with a heavy dependency ratio and insatiable subsistence demands hence more wetland is encroached on to provide for the basic food requirements for the family. The food requirements would on the other hand tend to increase with the increasing number of dependants in the family hence more and more of the wetland is farmed.

I.Table 4.12: Results of the regression analysis between the percent wetland used and selected socio-economic variable.

Var. No.	Var. name	Const-ant	Coeff-icient	R-Square	Compu-ted F	Tabled F at 0.05	Sigf. at 0.05
1	Size of wtl	3.971	-0.219	0.0240	(1,98) 2.41	3.92	-
3	Farm size	3.933	-0.111	0.0187	(1,96) 1.82	3.92	-
4	Family size	4.280	0.292	0.0498	(1,98) 5.13	3.92	*
5	No. of crops grown	4.364	-0.205	0.0151	(1,90) 1.38	3.92	-
6	wtl. tenure system	3.468	0.154	0.0035	(1,98) 0.35	3.92	-
7	Level of edn.	3.774	-0.172	0.0010	(1,97) 0.10	3.92	-
8	Time used	3.262	0.123	0.0272	(1,96) 2.68	3.92	-
9	purp. for the prdc.	3.834	0.017	0.0002	(1,90) 0.02	3.92	-
10	Age of wtl. user	3.768	-0.042	0.0016	(1,98) 0.15	3.92	-
11	Off farm ocpn.	3.831	-0.104	0.0012	(1,97) 0.12	3.92	-

- represents no significant relationship at the 0.05 level of confidence.
* represents a significant relationship at the 0.05 level of confidence.
Source: Fieldwork.

However, the rest of the selected variables had no significant linear relationship with the dependent variable.

this implies that either there could be other factors other than those selected or that the selected factors were intercorrelated with other factors not involved in the test.

4.5. The role of interdependent factors in influencing wetland cultivation.

This section highlights the role of interdependent factors influencing wetland cultivation in the study area. This factors were sought as its seldom to find one individual variable affecting a social phenomenon without the interaction of other variables. These interacting variables will thus form a pattern of interdependent variables.The hypothesis; certain patterns of interdependence among the selected socioeconomic variables influence the percentage of wetland cultivated is examined. To arrive at conclusions, the factor analysis results in tables 4.13, 4.14, 4.15 and 4.16 were used.

4.5.1. Results of factor analysis

Factor analysis technique transforms the original variables into new uncorrelated variables. It was found suitable to be used in the study as it would enable the researcher explain those interdependent factors detemining the increase in the percentage wetland cultivated by a farmer. The analysis produced a set of descriptive variables in terms of a small number of factors. Five factors were initially considered from a total of eleven basing on the eigen values (/\ ).

The five factors gave real eigen values while the

remaining six that were rejected gave trivial eigen values of a negative significance. Table 4.13 shows the eigen values obtained for each of the principal five factors retained.

Table 4.13: Eigen values of principal 5 factors retained.

Factor	Eigen value	Difference	proportion
1	1.922	1.006	0.684
2	0.916	0.430	0.326
3	0.486	0.178	0.173
4	0.308	0.189	0.110
5	0.119	0.131	0.042

Source: Field data.

From this table the following observations were made:

(a) Factor one has a eigen value of 1.922, this factor thus accounts for 17.47 percent of the total variance i.e. (1.922 * 100% /11) in the dependent variable;

(b) Factor 2 with a eigen value of 0.916 accounts for 8.33 percent of the total variation;

(c) Factor 3 with a eigen value of 0.486 accounts for 4.42 percent of the total variation;

(d) Factor 4 with eigen value of 0.308 accounts for 2.8 percent of the total variation; and

(e) Factor 5 with a eigen value of 0.119 accounts for 1.08 percent of the total variance.

In total, the five factors account for 34.1 percent of variation while 65.9 percent is the cumulative uniqueness contributed by each of the original variables.

Table 4.14 shows factor loadings on each of the variable, the communalities and uniqueness.

Table 4.14: Factor loadings.

Factor loadings.

Variable	1	2	3	4	5	h^2	Uniqueness
Var 2	-0.287	-0.126	0.127	0.193	-0.027	0.152	0.847
Var 1	0.661	0.297	-0.123	-0.62	0.060	0.584	0.453
Var 3	0.775	0.289	0.014	0.067	-0.069	0.693	0.307
Var 4	0.442	-0.036	-0.294	-0.029	0.099	0.294	0.706
Var 5	0.166	-0.059	0.313	-0.293	0.050	0.218	0.762
Var 6	-0.301	-0.074	-0.276	0.133	0.194	0.227	0.773
Var 7	-0346	0.576	0.038	-0.057	0.142	0.411	0.569
Var 8	0.153	-0.211	0.335	-0.013	0.189	0.212	0.788
Var 9	0.249	0.252	0.275	0.279	0.038	0.281	0.719
Var10	0.439	-0.551	-0.047	-0.052	0.036	0.503	0.497
Var11	0.302	-0.212	0.052	0.272	0.026	0.213	0.787

Source: Field data.

It is observed that variable 1 and 3 loads highly on factor 1 while variables 4, 10 and 11 load moderately on this factor. Variables 5, 8 and 9 load low on factor 1. Variable 2, 6 and 7 load negatively on this factor showing an inverse relationship between their own patterns and the average pattern as isolated by the factor analysis technique. Variable 7 loads highly on factor 2 while variable 10 loads high on the same factor though negatively. Other remaining factors do not show distinct patterns. The proportion of variance for each variable explained by all the five unrotated factors is also shown in the table; the communalities -h^2. The

proportion of the total variance accounted for by the 5 factors is:

(a) 58.4 % in variable 1;

(b) 15.2 % in variable 2;

(c) 69.3 % in variable 3;

(d) 29.4 % in variable 4;

(e) 21.8 % in variable 5;

(f) 22.7 % in variable 6;

(g) 41.1 % in variable 7;

(h) 21.2 % in variable 8;

(i) 28.1 % in variable 9;

(j) 50.3 % in variable 10; and

(k) 21.3 % in variable 11.

The varimax factor rotation was done to remove intercorelations between the initial 5 factors extracted by maximizing variance in the cosines. The closer the loadings, the greater will be the potential contribution of each loading to the total variance accounted for by the factor. Hence, this was done in order to have a clearer group identification. The results of the rotation are shown in table 4.15. From this table, it is clear that variable 10 (age of wetland farmer) and variable 3 (farm size) are both highly positively loaded in the data set on rotated factor 1. For factor 2, variable 1 (size of wetland) and 3 (farm size) are both highly positively loaded in the data set.

Table 4.15: Varimax rotation.

Rotated factor loadings.

Variable	1	2	Uniqueness
Var 2	-0.184	-0.254	0.847
Var 1	0.420	0.590	0.453
Var 3	0.523	0.641	0.307
Var 4	0.400	0.192	0.706
Var 5	0.173	0.033	0.762
Var 6	-0.222	-0.216	0.773
Var 7	-0.560	+0.271	0.589
Var 8	0.233	-0.096	0.788
Var 9	0.066	0.343	0.719
Var 10	0.657	-0.254	0.497
Var 11	0.367	-0.030	0.787

source: Field work.

The next task was then to label the selected significant factors derived from the varimax factor analysis rotation in order to facilitate data interpretation. The orthogonal varimax rotation of the initial 5 factors extracted resulted into 2 factors that were orthogonal to each other. These factors were named basing on variable loadings on each factor (Table 4.15). The loadings are either positive or negative. In each category a loading is high, medium or low*. Using this distribution, the following were found.

* - loadings above 0.5 were rated high while those between 0.1 and 0.5 were rated medium. Those less than 0.1 were rated low.

Factor 1: Land-demographic background of a household.

Positive.

high: Farm size, age of farmer.

Medium: size of wetland, family size, number of crops grown, length of time under utilization.

Low: purpose for which the crops are produced.

Negative.

High: level of education.

Medium: percent wetland used, land tenure system, off farm occupation.

Low: none.

Factor 2: Financial gains from wetland cultivation.

Positive:

High: size of wetland, farm size.

Medium: Family size, purpose for which the crops are grown, level of education.

Low: Number of crops grown.

Negative:

High: None.

used, age of farmer.

Low: Length of time that the wetland has been in use, off farm occupation.

Medium: Land tenure system, percent wetland

Two factors used in this analysis are given the following labels:

Factor 1: Land-demographic background of a household,

Factor 2: Financial gains from wetland cultivation.

Generally, these factors can be described as the socio-economic characteristics of individual wetland farmer. For each factor the significant variables are those with high and medium loadings. For instance, for factor one the most significant variable is variable 10 (age of the farmer) the communality of this being 0.432 meaning that 43.2 percent is the proportion of variation in the variable accounted for by this factor. Next in the order of significance in this factor is variable 7 (education level of the farmer) whose communality is 0.313 meaning that 31.3 percent of the variation in the variable is accounted for by the factor. It is worth noting that this variable is negatively related to the factor. Next in significance is variable 3 (farm size) whose communality is 0.273. This is followed by variable 1 (size of the wetland) with a communality of 0.177. Family size follows size of wetland in significance with a communality of 0.16.

For factor 2 (financial gains from wetland cultivation) the most significant variable is variable 3 (farm size) whose communality is 0.410 which shows that 41 percent of the total variation in the variable is accounted for by the factor. This variable is followed by variable 1 (wetland size) in which 34.7 percent of its variation is accounted for by factor 2.

Factor 1 (land-demographic background of a household) explains the reasons behind the increasing percentage wetland cultivation in the study area. As seen, variable 10 and variable 3 are the most significant variables for the factor. The important variables considered in this factor together with farm size and age are size of wetland, family size, number of crops grown and length of time (in years) that the wetland has been in use.

Most of the wetland farmers are in the active age of 30-39 years with a mean family size of 7.5 children/ dependants as such, they have large families whose basic needs have to be met. Due to shortage of available well drained land, a household finds it difficult to provide for itself with sufficient food supplies. As a result, farmers are now turning to the marshlands, swamps and river banks in their farms in search of additional land. Therefore by virtue of population pressure resulting in smaller subdivisions of land and the fact that the well drained land is left for cane growing,wetlands are bound to be cultivated even more. Hence it is expected that the percent wetland cultivated by a household will tend to increase with increasing land plots and increasing population pressure. This phenomenon is further demonstrated by the prevailing land tenure system of father to son kind of inheritance of the wetlands.

Before discussing factor 2, it is necessary that the choice of the factor label; financial gains from wetlands be clarified. Although 95 percent of the respondents did not market any of the wetland produce, it should be noted

that the money which could have been used to purchase food for domestic consumption is saved by using the wetland. Such money is then put into other domestic uses like children's fees, clothing, improvement of diet e t c. Thus such financial gains act as indirect income that accrues to the wetland farmer. It is also important to mention here that the economic status of the 5 percent who market some of their produce from the wetland will be relatively better as compared to their counterparts who do not market any of the wetland produce. Thus factor 2 explains that wetland farming is an important activity for the sample wetland farmers, in that the food harvested from the wetland plot is simultaneously for domestic and marketing purposes, thus representing a significant financial gain for the improvement of their socio-economic standards.

The food harvested is of great importance to the farmers as they supplement other sources of income. It should be realised that the majority of those interviewed affirmed that they did not have any off-farm occupation hence relied on land for income and for those with big sons and daughters, depended on this for some money once in a while. Mumias Division has been labelled a food deficit area with most of the maize consumed here coming as far off as from Kabras division and from Mt. Elgon District. The situation has deteriorated to such levels that only a handful of farmers are able to get enough food to last the household from one harvest to another. With these conditions, a farmer will not hesitate to encroach on the wetlands in an attempt to produce more food for the