Fish Production Systems and Water Quality, Pollution and Parasitic Effects on Farmed Fish in Nyeri County, Kenya

A Proposal Submitted in Fulfillment of Requirements for Doctor of Philosophy Degree of University of Nairobi (Fish Science)

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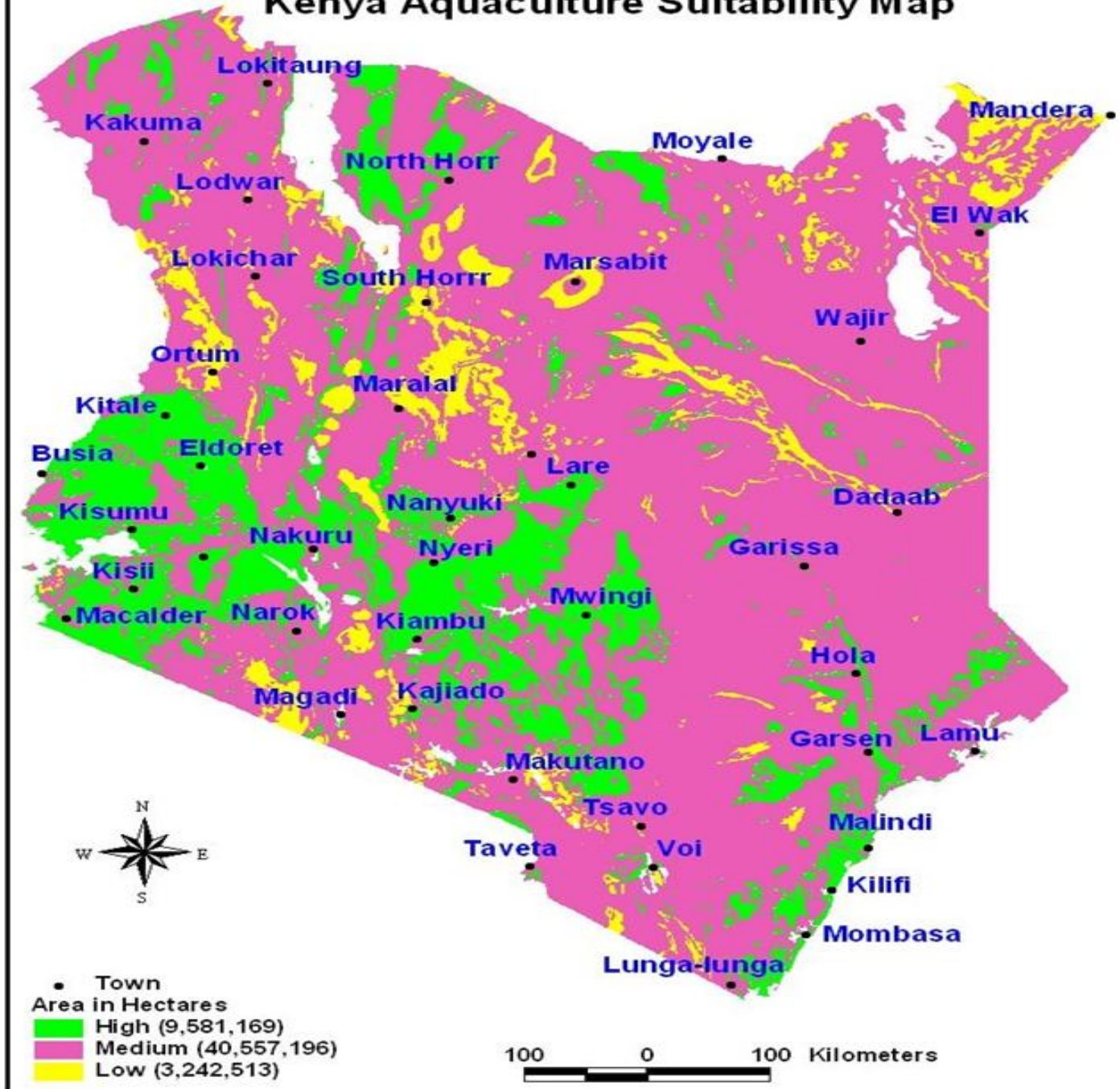4. Prof. Mbaria, J.M. (BVM, MSc., PhD)

Introduction

- Climate and environmental changes (water unavailability and reduced land cover) have increased food insecurity (Gregory *et al.*, 2005)

- In developing countries food insecurity is attributable to growing human population, changing diets, increased demand for meat products and competition for resources (CARE, 2011)

- The fastest growing food production sector in the world is aquaculture (FAO, 1999)

- Fish is a vital source of protein and other nutrients for the ever increasing population
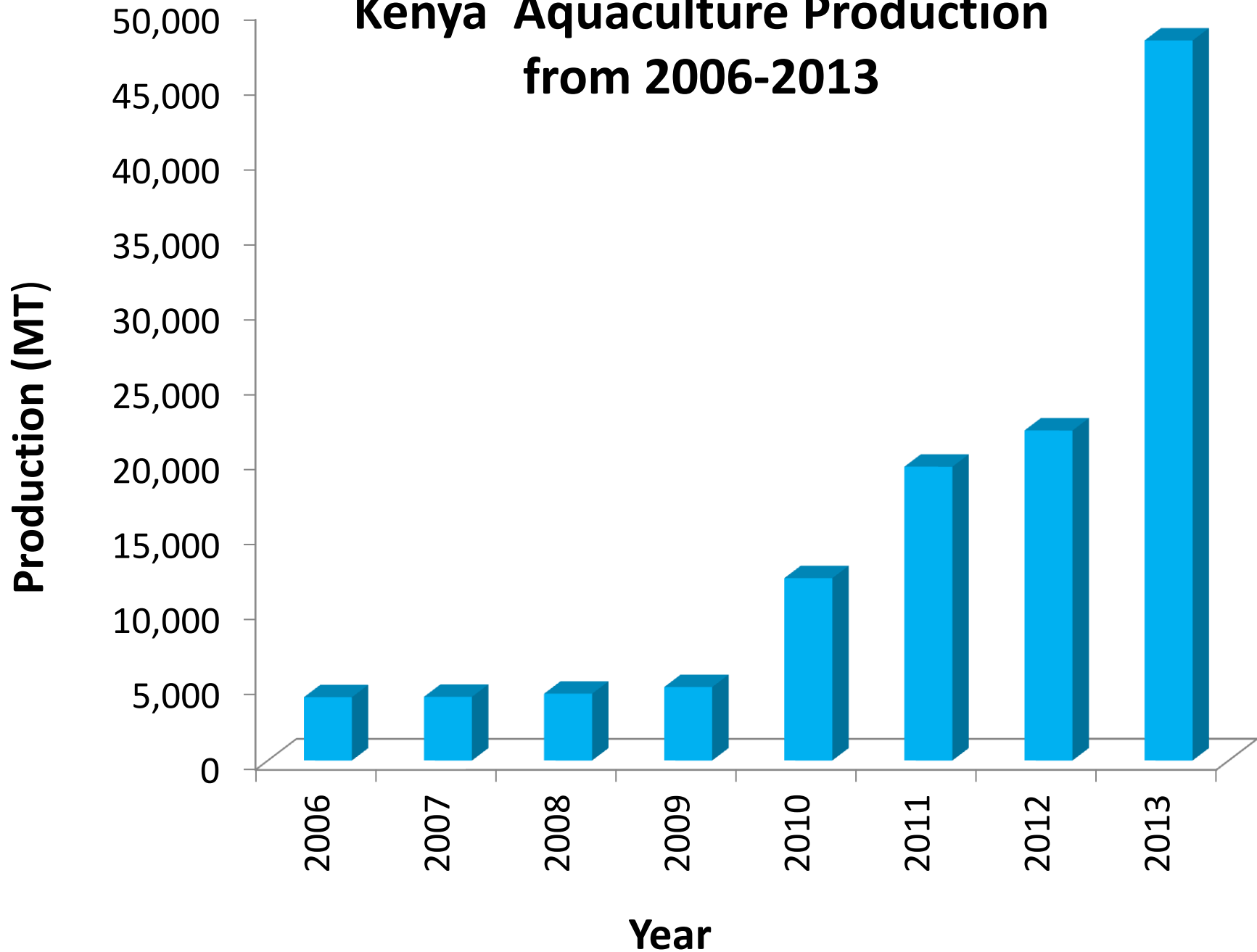
Introduction cont'd

- Kenya has water resources (Indian Ocean, lakes, rivers, swamps, ponds and other wetlands) with a high aquaculture potential for fish production

- In Kenya, Tilapia farming started in 1920s, and catfish and others thereafter (Mbugua *et al*., 2008)

- The economic Stimulus Programme (ESP) has facilitated the construction of over 46,824 fish ponds in 160 Constituencies country-wide. This program has renewed interest in fish farming in the country

- Fish farming is practiced in Nyeri County for subsistence and commercial purposes

Kenya Aquaculture Suitability Map

Lokitaung

Kakuma

Lodwar

North Horr

Moyale

Mandera

Lokichar

South Horrr

Marsabit

El Wak

Wajir

Ortum

Maralal

Kitale

Busia

Eldoret

Lare

Kisumu

Nanyuki

Dadaab

Kisii

Nakuru

Nyeri

Garissa

Macalder

Narok

Kiambu

Mwingi

Hola

Magadi

Kajiado

Garsen

Lamu

Makutano

Tsavo

Malindi

Taveta

Voi

Kilifi

Mombasa

Lunga-lunga

N
W   E
S

- Town

Area in Hectares
- High (9,581,169)
- Medium (40,557,196)
- Low (3,242,513)

100   0   100   Kilometers

Kenya Aquaculture Production from 2006-2013

Eat more fish campaign (8 Jan 2014, Othaya)

Challenges in the Kenyan Aquaculture Sector

• Lack of need-based research

•Inadequate supply of good quality fish feed

•Lack of a comprehensive aquaculture policy

•Poor extension services

•Inadequate supply of good quality fish seed (fry and fingerlings) (Munguti *et al*. 2014)

• The explosive interest in fish farming stimulated by the ESP poses new challenges ranging from environmental pollution, biosecurity, and the spread of fish diseases.

General objective

- To characterize fish production systems and evaluate the effects of water quality, pollution and parasitism on farmed tilapia and catfish in Nyeri County, Kenya

Specific objectives of this study are to:

1. Characterize fish production systems in Nyeri County, Kenya

2. Determine the physical and chemical quality of water

3. Determine the types and quantities of pollutants in water and farmed fish (catfish and tilapia)

4. Determine the seasonal prevalence and intensity of ecto- and endo-parasites in tilapia and catfish

5. Determine the pathology associated with water quality, pollutants and parasites in tilapia and catfish

Justification

- Production systems influence the types of pollutants, diseases and parasites found in water and in farmed fish.

- Water fed into fish ponds may contain pollutants (heavy metals and agrochemicals) from runoff waters, sewage, effluents and domestic waste. Their presence in water and farmed fish may affect fish quality and human health

- The seasonal prevalence and intensity of ecto- and endoparasites in farmed tilapia and catfish in Nyeri County is not available

- Information on the pathology associated with water quality, pollutants and parasites in farmed Tilapia and catfish is not available
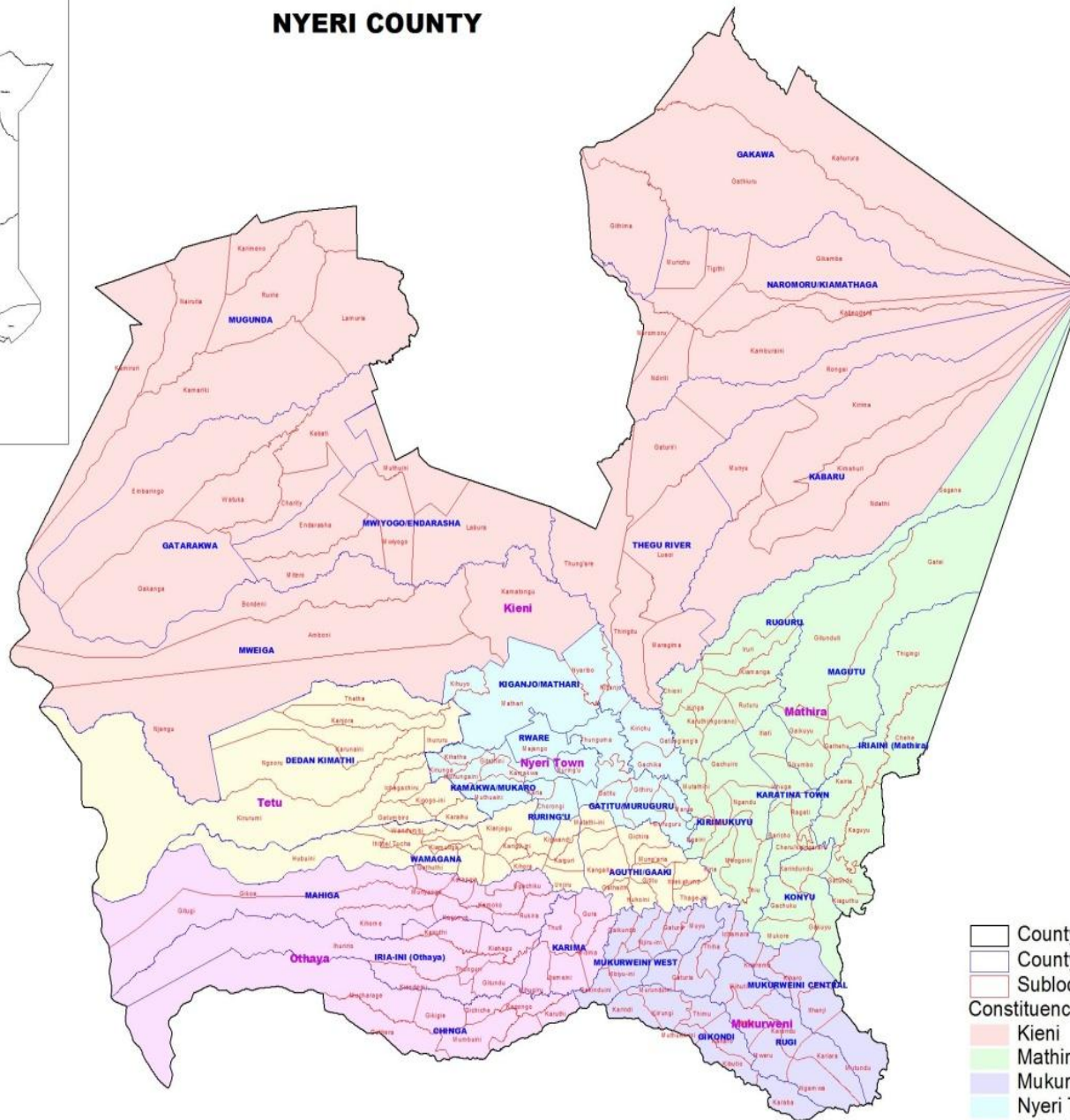
3.0 Materials and Methods
3.1 Study area

Study will be in Nyeri County, situated Longitudes 36º 038' East and 37º 020' East; and Latitude 00º 380' South

- Temperature ranges between 12º and 27 ºC

- Annual rainfall averages 550mm in lowland and 1500mm in the highlands

- Half of Nyeri is agro-ecological zone II while Kieni which is on the leeward side of Mount Kenya is semi-arid

- Farmers in Nyeri County grow tea, coffee and other crops; dairy and beef farming and fish keeping

NYERI COUNTY

County Boundary
County Assembly Ward Boundary
Sublocations Boundary
Constituency Boundary
Kieni
Mathira
Mukurweni
Nyeri Town
Othaya
Tetu

Materials and Methods cont'd

3.2 Characterization of fish production systems

- A questionnaire will be designed, pretested and administered to 250 randomly selected respondents in Tetu and Kieni divisions of Nyeri County. Focus group discussions will also be held with key informants.

- This questionnaire will be used to determine fish production systems, types of fish, types of pollutants, their source and effects on farmed fish

Materials and Methods cont'd

3.3 Physical and chemical analysis of water

- 146 water samples based on the formula $n=Z_{2\alpha}pq/L^2$ by Thrustfield, (1995) will be collected randomly from fish ponds and rivers using one liter sample bottles during the long and short rains, and the dry season

- Water samples will be transported and analyzed at Kenya Government Chemist Laboratories.

- The water samples will be tested for physical indicators (water temperature, conductivity, total suspended solids, turbidity, total dissolved solids, odor, color and feed remnants) and chemical indicators (pH, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen and total hardness).

Materials and Methods cont'd

3.4 Analysis for presence of pollutants in fish tissues

- Fish tissue samples will be analyzed for heavy metal and pesticide residues

Heavy metal analysis

- Heavy metals will be analyzed using Atomic Absorption Spectroscopy (AAS) for Hg, Lead, Arsenic, Cadmium at Department of Geology Laboratories, Nairobi.

Pesticides analysis

- Pesticide analysis will done using Gas Liquid Chromatographic (GLC) technique for Organochlorines, organophosphates and pyrethroids at PHPT, CAVS

Materials and Methods cont'd

3.5 Seasonal prevalence and intensity of ecto- and endo-parasites

Study fish

- 384 fish ($N = 1.96^2 PQ / L^2$ by Martin *et al.*, 1987) will be purchased from fish farmers during long and short rains; and dry season.

- The parasites will be collected, counted and recorded.

- The parasites will be identified using Commonwealth institute for helminthology (CIH) Keys

Materials and Methods cont'd

3.6 Fish post mortem examination and histological processing

•Fish post mortem examination will be done as described by Meyers (2000). Gross lesions will be noted and recorded.

•The liver, gills, kidney, gonads, heart, spleen, gastro-intestinal tract, muscle and the eye will be sampled for histopathology as described by Kamundia (2011).

•Tissues for histology will be fixed in 10% neutral buffered formalin and processed as described by Luna (1965) and Meyers (2000).

Data presentation & analysis

- Data from the questionnaires will be entered into Microsoft Excel. The proportions of responses will be ranked as follows; 1%-19% - Very low, 20%-39% - Low, 40%-59% -Average, 60%-79% - High and 61%-100% - Very High.

- Parasite distributions will be described using prevalence as described by Margolis *et al*. (1982) and Ford (1988).

- Morphometric values, gross and histological lesions' data will be entered into MS Excel (Microsoft 2007) and later imported into SAS v9.2 © 2008 for descriptive statistics and tests of association will be computed.

Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May
Activity												
Registration	X											
Questionnaire administration and data analysis		X										
Collection and analysis of water samples			X	X	X	X	X	X	X	X	X	X
Purchase of Laboratory materials		X										
Purchase of fish and postmortem examination			X	X	X		X	X		X	X	X
Laboratory work					X	X		X	X			X
Data analysis												X

Activity	Required inputs and unit cost (KShs)		Estimated total cost (KShs)
Application for legibility	Application fees		4,000
Registration	Composite fees		640,600
	Year 1	@ 158,200	
	Year 2	@141,200	
	Year 3	@141,200	
	Research money	@200,000	
Questionnaire administration	Development of Questionnaires	@ 4,600	162,150
	Questionnaires Pretesting	@ 13,000	
	Training of enumerators	@ 41,750	
	Questionnaire administration	@ 100,500	
	Stationery	@ 2,300	
Water sample analysis	150 samples	@ 1,000	150,000
Analysis for heavy metals in water	150 samples	@1,000	150,000
Analysis for pesticides in water	150 samples	@7,000	1,050,000
Analysis for heavy metals in fish	200 samples	@ 1,000	200,000
Analysis for pesticides in fish	200 samples	@ 7,000	1,400,000
Purchase of fish	384 samples	@300	115,200
Laboratory chemicals and materials	Assorted		200,000
Travelling logistics	4,000 km	@ 30.00KShs/KM	126,000.00
Overhead costs	10% Contingency		419,795
GRAND TOTAL			4,617,745

THANK YOU FOR LISTENING