AFRICAN UNION
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES



MAPPING STUDY OF AQUATIC ANIMAL DISEASES - EASTERN AFRICA

Prepared by: Hamisi Nikuli, Ministry of Livestock and Fisheries Department, Department of Aquaculture, P. O. Box 9152, 15487, Dar es Salaam, Tanzania

Edited by: Nelly Isyagi, Mohamed Seisay and Simplice Nouala

Disclaimer: The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the African Union Interafrican Bureau for Animal Resources.

Citation: AU-IBAR, 2016. Mapping study of aquatic animal diseases in Africa – Eastern Africa . AU-IBAR Reports

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders.

Published by AU-IBAR, Nairobi, Kenya
Copyright: © 2016 African Union – Interafrican Bureau for Animal Resources (AUIBAR)

ISBN 978-9966-1659-5-4

Requests for such permission should be addressed to:
The Director
African Union – Interafrican Bureau for Animal Resources (AU-IBAR)
Kenindia Business Park
Museum Hill, Westlands Road
P.O. Box 30786
00100, Nairobi, KENYA
Or by e-mail to: ibar.office@au-ibar.org

TABLE OF CONTENTS

	ACRONYMS	***v***
	ACKNOWLEDGMENTS	***vi***
	FOREWARD	***vii***
1.	***BACKGROUND TO THE STUDY***	***1***
2.	***PURPOSE AND SCOPE OF THE STUDY***	***1***
2.1	*Purpose of the study*	*1*
2.2	*Scope of the study*	*2*
2.3	*Period of implementation*	*2*
3.	***METHODOLOGY***	***2***
3.1	Data Collection	2
4	***AN OVERVIEW OF THE STATUS OF AQUACULTURE IN THE REGION***	***3***
4.1	*A Description of the Fish Production Systems in the Region*	*3*
4.2	*A Comparative Overview of the Levels and Systems of Production*	*4*
5.	***STATUS OF AQUATIC ANIMAL DISEASE IN THE REGION FOOD SAFETY AND AQUATIC ANIMAL HEALTH.***	***4***
5.1	*Prevalence and Incidences and of aquatic animal diseases in the region*	*5*
5.3	*A Brief Overview of the Factors associated with the occurrence and spread of aquatic animal diseases in the region*	*9*
6.	***OVERVIEW OF AQUATIC ANIMAL DISEASE CONTROL IN THE REGION***	***10***
6.1	*Presence of National and Regional Aquatic Animal Disease Control Policies and Measures.*	*10*
6.2	*Opportunities, Issues and Challenges for Aquatic Animal Disease Control in the Region*	*11*
7.	***CASE STUDY TANZANIA: AQUATIC ANIMAL DISEASE PATTERNS AND CONTROL MEASURES WITHIN COUNTRIES VISITED – STATUS AND COMPARATIVE ANALYSIS***	***12***
7.1	*An Overview of Aquaculture Production and Development in Tanzania*	*12*
7.2	*Incidences, Prevalence and Disease Distribution Patterns*	*12*
7.3	*Risk Factors and Determinants*	*13*
7.4	*Disease control Approaches.*	*13*
7.5	*Observations and Recommendations*	*13*
8.	***A SITUATION ANALYSIS OF THE AQUATIC ANIMAL DISEASE STATUS IN THE REGION***	***14***
9.	***RECOMMENDATION AND OPINIONS FROM REGIONAL FISHERY BODIES (RFBs) AND REGIONAL ECONOMIC COMMUNITIES (RECs)***	***19***
	REFERENCES	***22***
	ANNEXES	***24***

LIST OF FIGURES

Figure 1: *Study area Eastern African Region (EAC and IGAD) countries* 2
Figure 2: *Regional Prevalence of Aquatic Animal Pathogen* 6
Figure 3: *Pathogen Distribution in the Eastern Africa Region* 6
Figure 4: *Distribution of Reported Aquatic Animal Diseases by country in the Region* 8
Figure 5: *Prevalence of Aquatic Animal Diseases in Tanzania* 12
Figure 6: *Fish Species Sanitary Map* 17

ACRONYMS

AAH	Aquatic Animal Health
ACP Fish II	African, Caribbean and Pacific Fish II
AU	African Union
AU-IBAR	The African Union Interafrican Bureau for Animal Resources
BMPs	Basic Management Practices
CA	Competent Authority
DRC	Democratic Republic of Congo
EAC	East African Community
FAO	Food and Agriculture Organization of the United Nations
IGAD	The InterGovernmental Authority on Development
Kg	Kilogram
NEPAD'S CAADP	The New Partnership for Africa's Development's Comprehensive Africa Agriculture Development Programme
OIE	Office International des Épizooties
Sp	Species
ToR	Terms of Reference

ACKNOWLEDGMENTS

The Director of AU-IBAR wishes to acknowledge the contribution of all the individuals and institutions from the Member States of Eastern Africa who participated in this study. Special thanks go to the consultants who undertook the study. Special thanks go to the consultant who prepared the document and the team at IBAR for the editorial work.

This work was done under the project 'Strengthening Institutional Capacity to enhance governance of the fisheries sector in Africa' Project number, DCI-FOOD 2013/331 -056, funded by the EU to whom we are grateful for the financial support.

FOREWARD

Africa's aquatic resources provide enormous potential and opportunity for fisheries and aquaculture development. If fully tapped, these resources have the potential to contribute significantly to socio-economic development and improve the livelihoods for Africa's citizens. Fisheries and aquaculture have consequently been prioritised as among the key agricultural value chains for transformation under CAADP framework. In recognition of this, the 'Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa' (PFRS) was subsequently endorsed as the blue print for transforming Africa's fisheries and aquaculture sectors by the Summit of African Union Heads of States and Government at Malabo in 2014. The overall goal of the PFRS is to create an enabling environment to support sustainable sectoral development and growth so as to increase the socio-economic benefits derived for the Continent's citizens in an equitable manner.

Realising these objectives entails ensuring the productivity of the aquatic and fishery resources. Threats to environmental biosecurity, of which fish diseases are both a sequel and contributor with the concomitant effects on food security, trade and income need to be contained. Africa has in the recent past experienced such incidences of transboundary aquatic animal diseases, notably White Spot Syndrome Virus in and Aphanomyces invadans infection (EUS) that have resulted into profound socio-economic losses for dependent communities.

During the outbreaks, the poor state of knowledge and skills on aquatic animal disease, their prevalence and control on the continent became obviously apparent. The inadequate human and institutional capacity for the detection, surveillance and control aquatic animal diseases at both national and regional level, exacerbated the spread and the negative environmental and socio-economic sequels of these outbreaks. Information on the sanitary status of aquatic stocks and infrastructure for the control of aquatic animal diseases was at the time found to be wanting.

Controlling and mitigating against threats to the continents aquatic animal production systems is a matter of concern. Establishing mechanisms for biosecurity governance and diseases control is thus among the result areas of the Fisheries Governance Project with the view to:

i. Preventing and controlling aquatic biological hazards that include pathogens, pests, toxins and new species;
ii. Increasing levels of aquatic animal production and efficiency;
iii. Improving access to markets for aquatic animal produce and products;
iv. Improving the economic benefits realised by producers, communities and nations accruing from aquatic animal production; and
v. Supporting sustainable aquatic environmental management.

To do this, baseline information of potential pathogens, disease incidence and prevalence is a basic requirement. However, the current low level information on the sanitary status of stocks in countries, within watersheds and of traded aquatic animal products continues to pose a threat to the fisheries and aquaculture makes it difficult to establish such systems. The information that shall be generated from these Regional Fish Disease Mapping Studies is therefore a foundational step towards strengthening Continental capacity for aquatic animal disease detection, surveillance and biosecurity control.

Prof. Ahmed El-Sawalhy
Director, AU-IBAR

1. BACKGROUND TO THE STUDY

The fisheries and aquaculture contribute 6% of the Africa's agriculture Gross Domestic Product (GDP). The Fisheries have been identified as among the key agricultural value chains for transformation under NEPAD'S CAADP framework as well as the Malabo Declaration. The overall aim of this initiative is to transform Africa's agricultural sector into one that fosters equitable socio-economic development.

The African Union Interafrican Bureau for Animal Resources (AU-IBAR) is a specialized technical office reporting to the Department of Rural Economy and Agriculture of the AU Commission. The Institution is mandated to support and coordinate the improvement of livestock, fisheries and wildlife as a resource for human well-being in the member states of the African Union and contribute to economic development, particularly in rural areas.

AU-IBAR's mandate is to support and coordinate the sustainable development and utilization of animal resources on the continent. Consequently, AU-IBAR plays a major role in enabling Member States (MS) achieve this goal. The key thematic areas of AU-IBAR's strategic plan are:

1. Animal health, disease prevention and controls,
2. Animal resource production systems and ecosystem management, and
3. Access to inputs, services and markets for animal and animal products.
4. Animal resources information and knowledge management

To this effect, in implementing the Fisheries Governance Project, it is working to support Member States towards the implementation of the Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa is to contribute towards the 'Sustainable management and utilization of fisheries and aquaculture resources by establishing aconducive and enabling environment for equitable, economic and social development in Africa'.

Accordingly the overall goal of the Fisheries Governance Project is to improve institutional and policy environment for sustainable management and utilization of fisheries resources in Africa.

2. PURPOSE AND SCOPE OF THE STUDY

2.1 Purpose of the study

The objectives of the proposed aquatic animal disease mapping study were to:

i. Determine the current status of aquatic animal diseases within countries.
ii. Establish the production systems (fisheries and/or aquaculture) where they occur.
iii. Establish disease risks determinants.
iv. Establish the geographical areas where these aquatic animal diseases have occurred.

2.2 Scope of the study

The consultancy was undertaken by desk, online research, questionnaires and correspondences. The study was conducted in the Eastern African Region that comprises the East African Community (EAC) and the Intergovernmental Authority on Development (IGAD) countries.

2.3 Period of implementation

According to the Terms of Reference (ToR), the period of implementation of the contract was given 42 days from the date of signature of the contract in which the Agreement was officially signed on 19th December 2015. However, AU-IBAR Administration directed the consultants to produce first draft of the report on 15th February 2016 and final report at end the of March 2016.

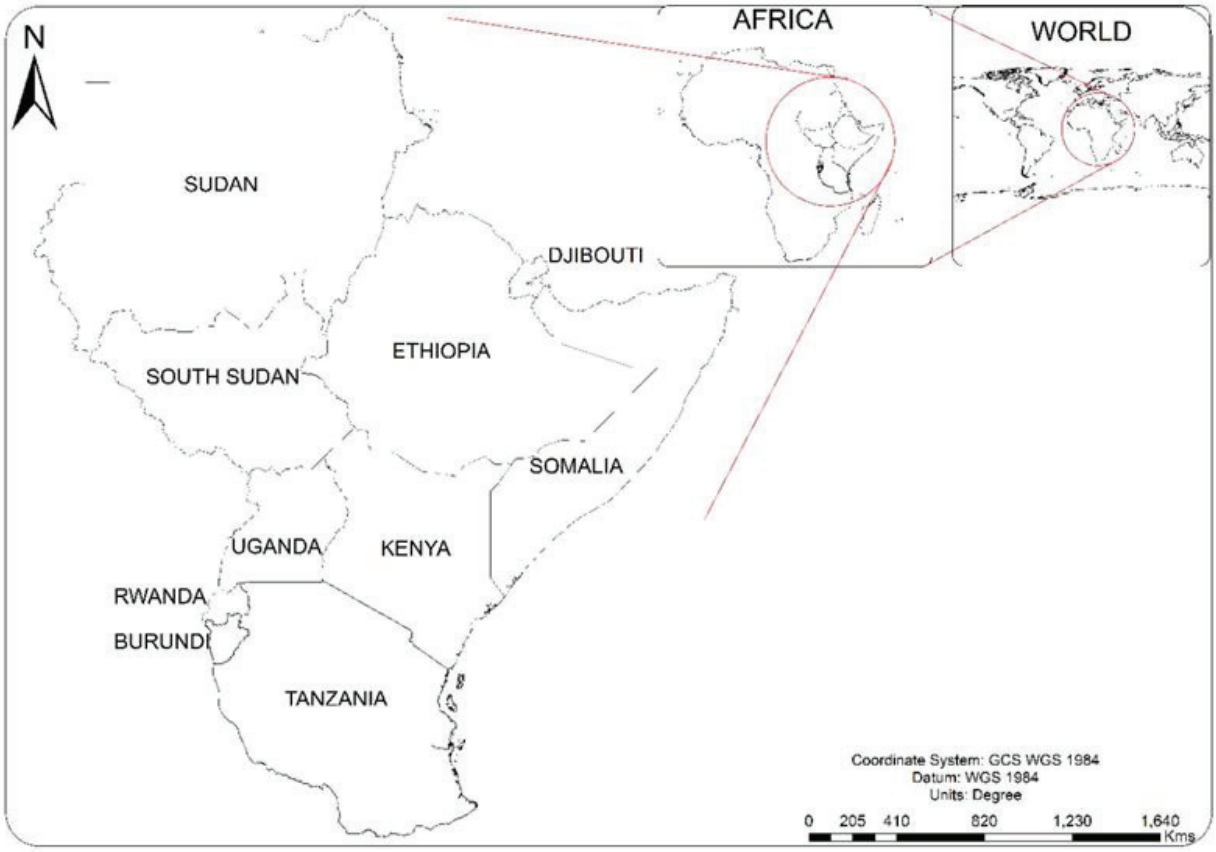


Figure 1: *Study area Eastern African Region (EAC and IGAD) countries*

3. METHODOLOGY

3.1 Data Collection

3.1.1 Primary data

The study planned to collect data from questionnaire, interviews with relevant stakeholders in the fishing industry to include; Aquaculture Department heads, Fisheries Officers, researchers, laboratory technicians, member of academic staff, veterinary officers, fish producers, fish health practitioners, fishermen, fish trader and fish processors. In the study questionnaires were sent to respective countries, RECs and RFBs. However, sixcountries (Kenya, Uganda, Rwanda, Burundi, Tanzania and Sudan) and one Regional Fisheries Bodies (Lake Victoria Fisheries Organization) responded to the questionnaires (Annex 6).

3.1.2 Secondary data

Secondary data involved synthesis of fish disease information from different sources a following review of publications. Secondary information sources included published articles in peer-review journals; presented paper in scientific gatherings; grey literature including technical reports from government agencies or scientific research groups; and working papers from research groups or committees. Collections in institutional libraries such as universities, fisheries research on aquatic animal diseases in the Region.

3.1.3 Data Analysis

Both primary and secondary data were descriptively analysed to describe the situation of Aquatic animal diseases in the Region. The locations of disease outbreak in Member States were Geo referenced for subsequent aquatic animal disease mapping.

4 AN OVERVIEW OF THE STATUS OF AQUACULTURE IN THE REGION

4.1 A Description of the Fish Production Systems in the Region

Globally, fish production has grown steadily over the last five decades with fish supply increasing at an average annual rate of 3.2 percent, outpacing world population growth at 1.6 percent. World per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 19.2 kg in 2012 with China increased an average annual rate of 6.0 percent in the period 1990–2010 to about 35.1 kg in 2010. FAO reported that, of the 126 million tonnes available fish for human consumption in 2009, fish consumption was lowest in Africa (9.1 million tonnes, with average of 9.1 kg per capita) (FAO, 2014).

Aquaculture has the potential to make a significant contribution to food security and income generation. Aquaculture is recorded as the earliest recorded history; Egypt, Kenya and Malawi were the earliest in eastern Africa which dates back to the beginning of the century. The industry started between 1940 and 1960 in Rwanda, Uganda Zambia, Zimbabwe and Tanzania in that order. The main aquaculture systems in practice are: monoculture, polyculture, using tilapia as the main species, mono or polyculture of tilapia with animal husbandry and rice-cum-fish culture (Dadzie, 1992). The cage culture of tilapia in Lake Victoria, Lake Kivu and possibly other lakes has a big potential provided that governments regulate a sustainable growth of this type of aquaculture.

Eastern Africa Region has high potential for aquaculture production with numerous lakes, rivers, wetlands and Indian ocean coastline; availability of suitable native species such as Nile tilapia (*Oreochromis niloticus*) and the African catfish (*Clarias gariepinus*); locally available required inputs for feed production; suitable temperature for fish growth; and expanded local, regional and international market access and trade (AU-IBAR, 2014).

The study revealed that, aquaculture consists primarily of small-scale pond systems where Tilapia and Catfish are the main species. Most of the farmers in the Region practice extensive aquaculture production methods with few semi-intensive production systems. The study realized that aquaculture is well developed in Uganda and Kenya, while in other countries aquaculture enterprise is relatively undeveloped. As capture fisheries decline and demand for fish increases and therefore, aquaculture intervention is important to fill the gap and provide the required fisheries resources in the region (FAO, 2014).

4.2 A Comparative Overview of the Levels and Systems of Production

Aquaculture systems in the Region vary considerably from between countries. According to this report, respondents reported that, Ponds, cages and plastic tanks are dominant systems in Kenya, Burundi and Uganda. In Tanzania, Ponds, Cages (in Lake Victoria and Lake Tanganyika) and Hapas are the main systems. The countries where aquaculture is at infancy stage (Sudan, Somalia, Ethiopia, Djibouti and South Sudan), pond is the system practicable in the countries. According to ACP Fish II (2013), Wilson Rutaganira, (2016), ponds, cages and plastic tanks are aquaculture production systems in Rwanda. Further information is available in Annex 5 of this report.

The cage culture of tilapia in Lake Victoria and possibly other lakes (Lake Tanganyika and Lake Muhazi) has a big potential provided that governments regulate a sustainable growth of this type of aquaculture. Systems of production by countries in the Region are presented in annex 5.

5. STATUS OF AQUATIC ANIMAL DISEASE IN THE REGION FOOD SAFETY AND AQUATIC ANIMAL HEALTH.

Fish is a globally acceptable meat food, being a valuable source of animal protein, minerals and vitamins that are essential requirements in human diets. Fish occupies a unique position in the agriculture sub-sector of the world economy as among the most affordable source of animal protein. Fish contributes immensely to the food and nutritional security, gainful employment and national revenues.

With the expansion and rapid development of aquaculture in Africa, the risk of fish disease outbreak also increases. Aquatic animal disease outbreaks impact aquaculture investments at farm and national levels interms of costs associated with aquatic disease management and reduced levels of production and returns (FAO 2002). Often, the success or failure of aquaculture enterprises rests on how effectively the producers and other stakeholders are able to manage aquatic diseases. Records show that success in managing disease results in high profits for producers and increased benefits for consumers (Kamel 2001).

There is little information on the status of aquatic animal diseases in the African. The burden of aquatic animal diseases on the continent may be underestimated because of poor documentation.. Lack of epidemiological data in terms of incidence and prevalence, as well as underreporting, hinder the implementation of disease control strategies.

Most studies on African fish pathogens have been carried out in western, central and southern Africa, whereas literature from eastern and northern Africa is scanty may be this caused by inadequate personnel experienced in fish parasitology (Aloo, 2002).

Findings from this study suggest that most of the studied diseases in the the region are non OIE listed. Of the EAC and IGAD, Uganda has the most studied pathogen (45%) compared to the remaining Member States followed by Tanzania (32.1%) and Kenya (20.7%) whereas, Burundi, Rwanda and IGAD countries are least studied countries in the Region.

Literature suggests that, monogeneans are more prevalent (17.8%), followed by protozoan parasites (17.2%), crustaceans (16.7%), nematodes (15.5%) and digenean parasites (11.5%) whereas, cestodes, bacterial, acanthocephalan and fungal infections were the least (see graph in section 5.1).

In Uganda, indications are that Monogenean (27.8%) and Protozoan (25.3%) parasites were more prevalent than others. This was followed by crustacean (19%) and Digenean parasites (10%). See Annex 1 for details of identified aquatic animal pathogens and their distribution annex 1.

In the study, no information on aquatic animal diseases was accessible to reveal the status of aquatic animal diseases diseases in Somalia, Sudan, Djibouti, South Sudan and Ethiopia. Except for Sudan, contact persons in these countries no responses were received to the questionnaires sent. Therefore secondary, literature review was the only option for data collection in these countries.

According to the data obtained in this study, 69.9% of investigations on occurrence of aquatic animal pathogen were undertaken in natural waters and only 30.1% of investigations were done in fish farms meaning that a lot need to be done for fish farms. This indicates a need to obtain information from fish farms.

The cited papers indicate that, only fish species were investigated leaving the rest of aquatic animals with little study coverage. It should be noted that, other aquatic species are equally important for food and trade. It must also be noted that, some aquatic animal species serve as pathogen reservoirs examples copepods play bigger role in transmitting white spot syndrome virus in shrimps (Melba, 2013).

5.1 Prevalence and Incidences and of aquatic animal diseases in the region

Most of the studied organisms are known to be non-pathogenic and they are of not considered notifiable in international trade. Some species of flukes (Platyhelminthes: Trematoda), such as *Gyrodactylus spp*., are ectoparasites of fish that can cause serious damage to cultured species (C.E. Hopla et al., 1994). Ectoparasites that affect the skin of the host (fish) at various periods can cause significant infestations with detrimental effects to fish. However, some parasites Arguloid (Copepods) are responsible for transmitting some fish Bacteria and viruses (while feeding) known to be pathogenic example White Spot Syndrome Viruses (Hopla et al., 1994). However, ectoparasites – especially in large aggregations – may debilitate the animals and invariably causing some disorders (Hopla et al., 1994) such as anaemia; detrimental immune reactions such as (hypersensitivity and anaphylaxis.); irritability; skin lesions; low weight gains; secondary infection; and/or inoculation of toxins.

Of the studied countries that responded to the questionnaire, only Rwanda and Tanzania responded that there had been reports of aquatic animal diseases. The rest gave a negative response for reports of aquatic animal diseases. Literature on the other hand reported pathogens even from such countries (Annex 1). This report outlines ten categories of organisms regarded to be pathogenic to aquatic animals in the region namely are Protozoa, Bacteria, Viruses, Monogenea, Digenea, Cestodes, Nematodes, acathoncephala, Crustacean and Fungus. They are prevalent in Tanzania, Uganda, Kenya, Burundi and Rwanda.

According to the study, regionally, monogenean parasites has the highest prevalence (17.8%) followed by protozoan (17.2%), crustaceans (16.7%), nematodes (15.5%) and digeneans (11.5%) whereas, cestodes (10.9%), bacteria (5.2%), *Acathocephala* (2.3%), fungi (2.3%) and viruses (1.1%) were the least. The information obtained for the study shows that there were proportionately more reports on aquatic animal pathogens from Uganda (45%), followed by Tanzania (32%) and Kenya (21%). Rwanda and Burundi has the least 1.5% and 0.5% respectively whereas, Sudan did not report any outbreak.

Figures 2 and 3 illustrate the findings of the study based on species and region(see Distribution maps in section 5.2).

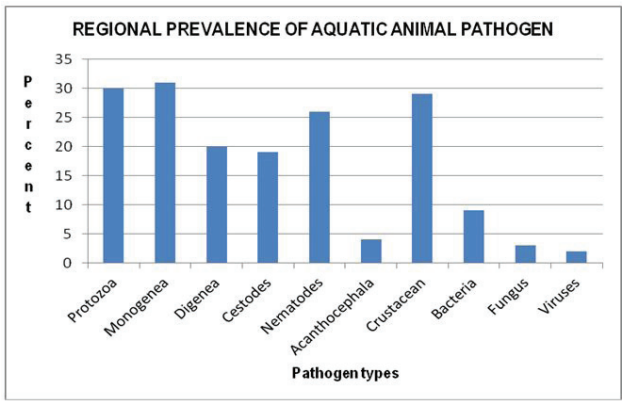


Figure 2: *Regional Prevalence of Aquatic Animal Pathogen*

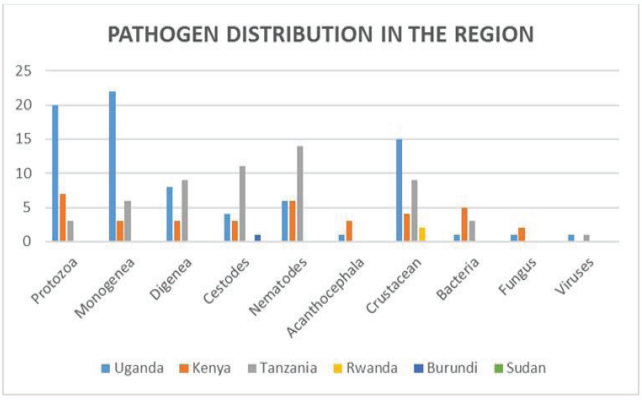
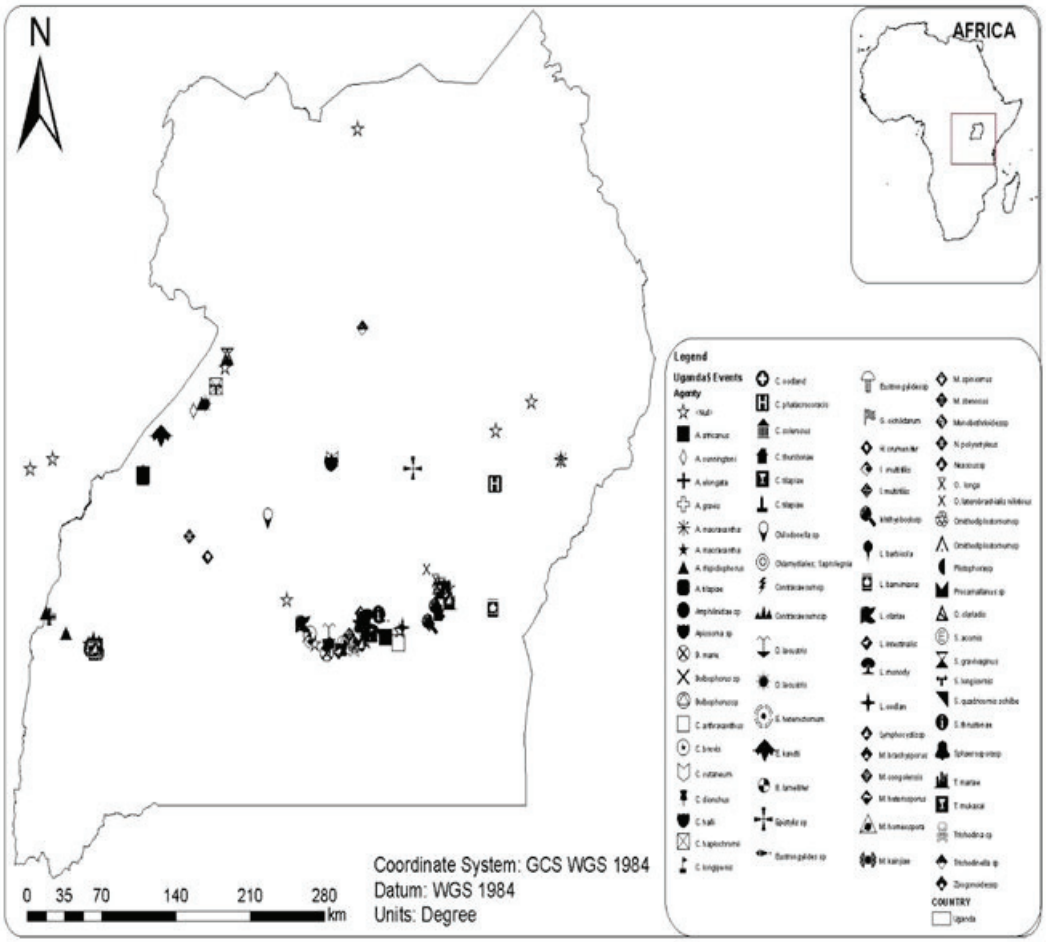
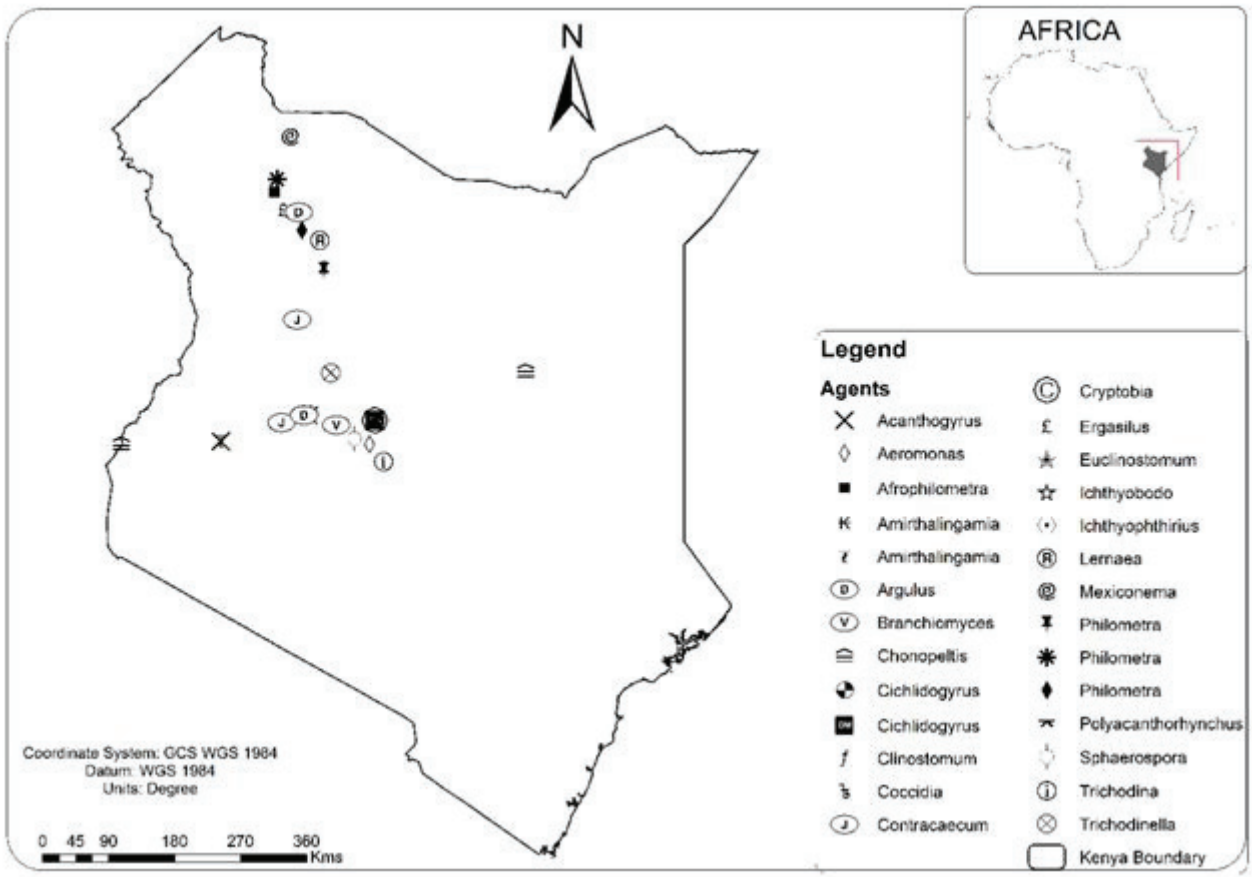
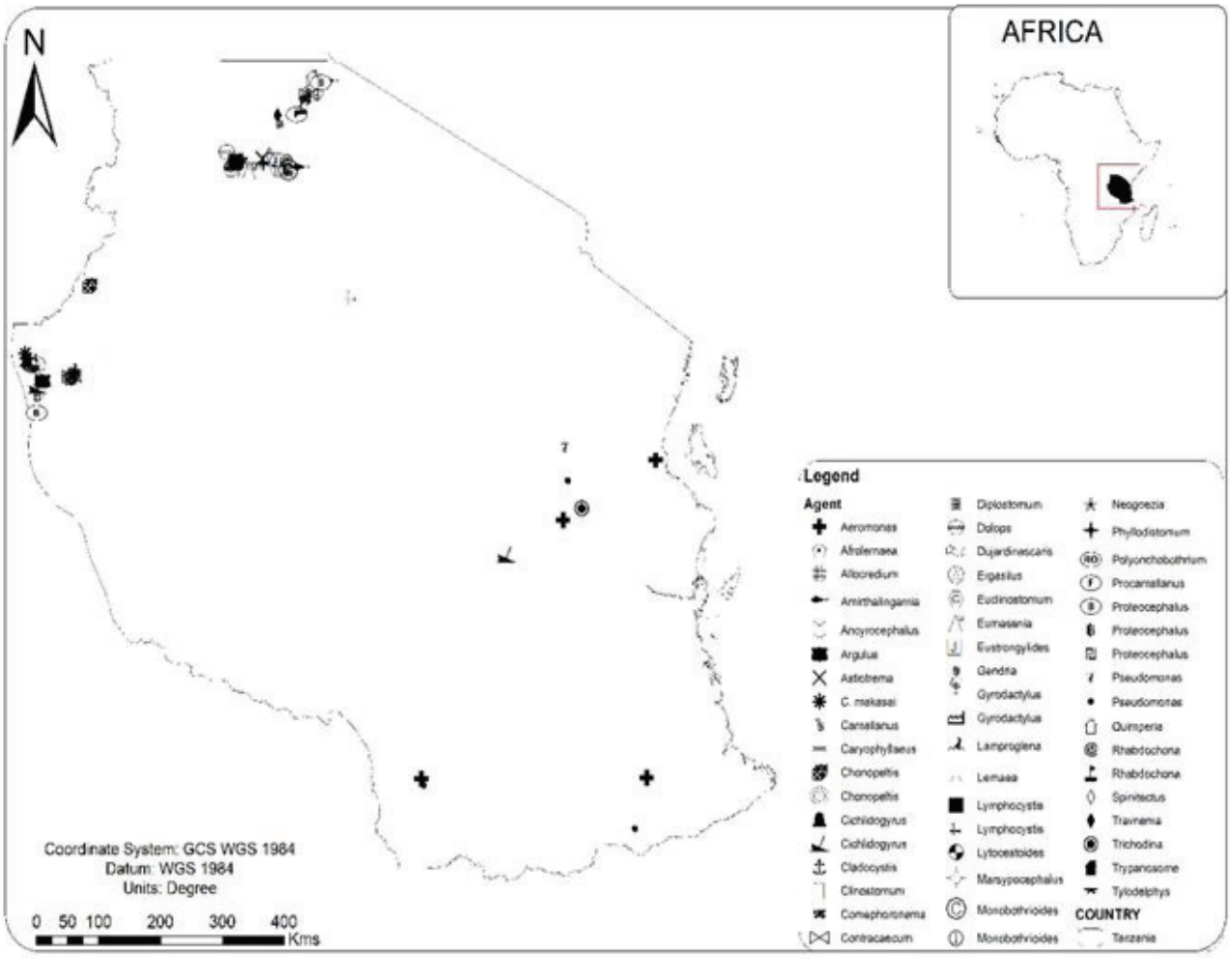
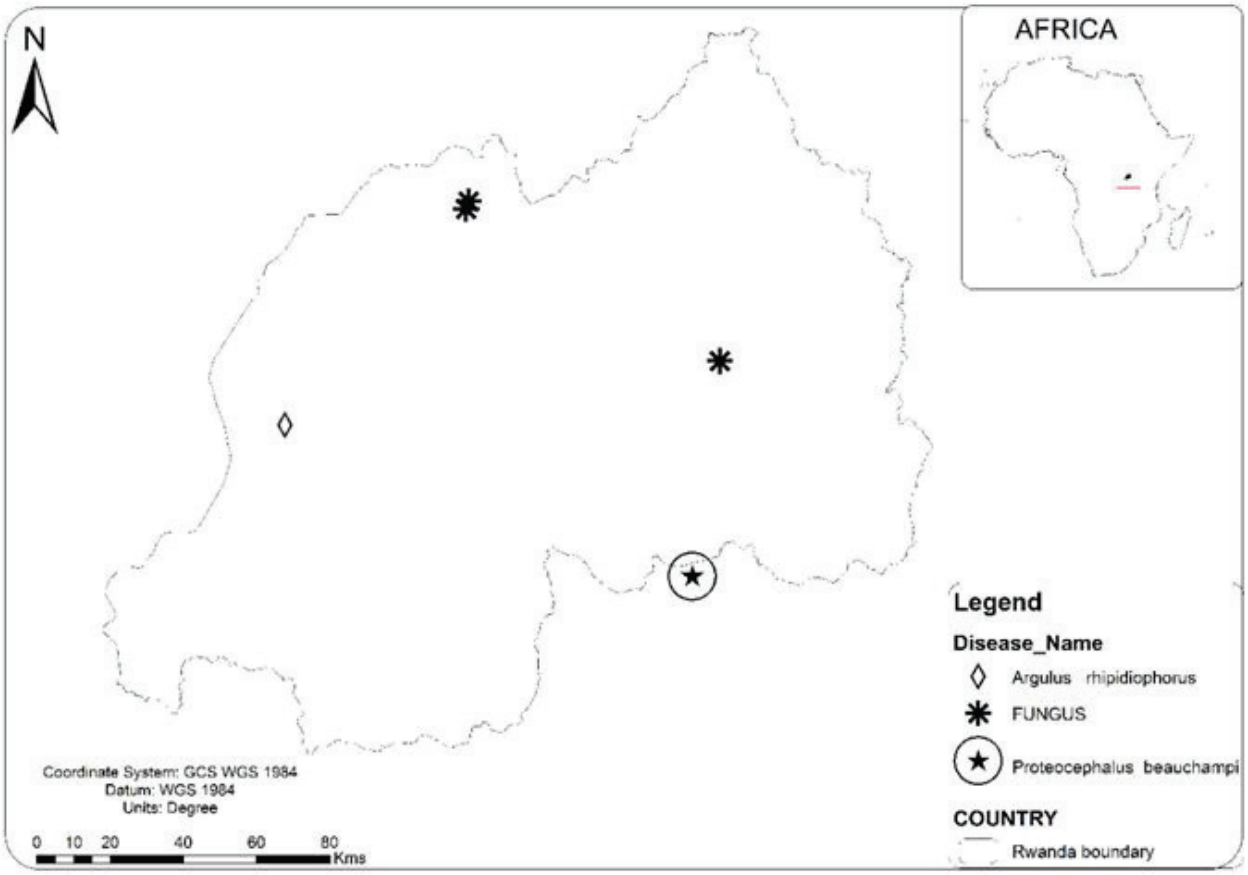


Figure 3: *Pathogen Distribution in the Eastern Africa Region*




N
AFRICA
Legend
Agents
Acanthogyrus
Aeromonas
Afrophilometra
Amirthalingamia
Amirthalingamia
Argulus
Branchiomyces
Chonopeltis
Cichlidogyrus
Cichlidogyrus
Clinostomum
Coccidia
Contracaecum
Cryptobia
Ergasilus
Euclinostomum
Ichthyobodo
Ichthyophthirius
Lernaea
Mexiconema
Philometra
Philometra
Philometra
Polyacanthorhynchus
Sphaerospora
Trichodina
Trichodinella
Kenya Boundary
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
0 45 90 180 270 360
Kms


N
AFRICA
Legend
Agent
Aeromonas
Afrolernaea
Alloredum
Amirthalingamia
Anoyrocephalus
Argulus
Astiotrema
C. mekasai
Carnallanus
Caryophyllaeus
Chonopeltis
Chonopeltis
Cichlidogyrus
Cichlidogyrus
Cladocystis
Clinostomum
Comephoronema
Contracaecum
Diplostomum
Dolops
Dujardinescaris
Ergasilus
Euclinostomum
Eumasenia
Eustrongylides
Gendria
Gyrodactylus
Gyrodactylus
Lamproglena
Lernaea
Lymphocystis
Lymphocystis
Lytocestoides
Mansyocephalus
Monobothrioides
Monobothrioides
Neogoezia
Phyllodistomum
Polyonchobothrium
Procamallanus
Proteocephalus
Proteocephalus
Proteocephalus
Pseudomonas
Pseudomonas
Quinqueria
Rhabdochona
Rhabdochona
Spiroxystis
Travnema
Trichodina
Trypanosome
Tylodelphys
COUNTRY
Tanzania
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
0 50 100 200 300 400
Kms



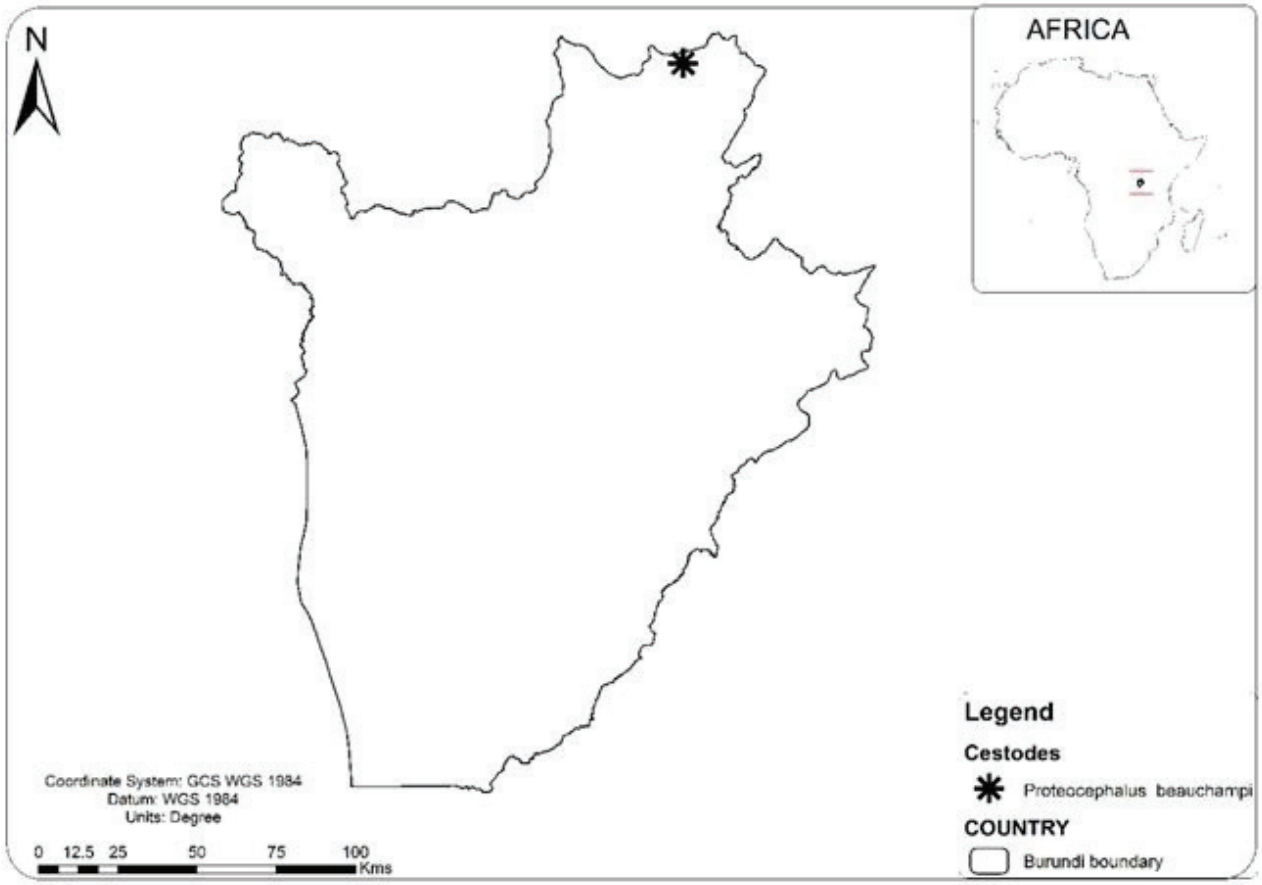


Figure 4: *Distribution of Reported Aquatic Animal Diseases by country in the Region*

5.3 A Brief Overview of the Factors associated with the occurrence and spread of aquatic animal diseases in the region

There are several factors contributing to the occurrence and spread of aquatic animal diseases in the region. Indeed, there are several factors contributing to poor biosecurity these are; intensification of farming, development and expansion of ornamental fish trade, misunderstanding and misuse of specific pathogen free (SPF) stocks in hatcheries, low levels of awareness on emerging diseases, unanticipated negative interaction, enhancement of marine and coastal feed (live feeds) (Reantaso. 2013).

Huchzermeyer (2014) outlined several factors associated with outbreak and spread of aquatic animal diseases in the wild and farm interface. Introduction of aquatic animal diseases is associated with risks which include; transfer of eggs and fish from infected to uninfected farm or environment; movement of birds or faeces of infected birds; Human movement from infected to uninfected areas; vehicles movement; movement of farm/fishing equipment, movement of wild or feral fish; and infected water example in case of floods. Whereas, transmission of these diseases is easily through horizontal pathway via water, asymptomatic carriers and vertically through gametes (Huchzermeyer, 2014).

Annex 3 (a and b) of this study report shows that, Uganda and Tanzania reported existence of predators, vectors/pathogen reservoirs and watershed as factors associated with aquatic animal disease occurrence and spread. Kenya reported production system and season of the year are factors whereas, Tanzania reported production system as a risk factor for disease outbreak. Uganda reported also season is a risk factor for aquatic animal disease to occur. Uganda also reported trade of live fish is a risk factor to disease outbreak in the country a case supported by Huchzermeyer (2014).

Burundi and Sudan did not indicate either of these as risk factors of disease probably because little is known about aquatic animal diseases in these countries or due to the fact that aquaculture development in these countries is at the initial stages.

The study also revealed that approximately 67% of the respondent Member States did not have the ability to provide health certificates for the movement of live aquatic animals.

Over 83% of respondent countries, stated that they sourced brood-stock from wild water. According to Reanatso (2013) where there are no health certification or quarantine facilities, biosecurity risks increase (Reanatso. 2013).

The study also noted that, 67% of the studied countries import or export genetic material between countries. As aquaculture continues to expand all over the world, emergency of aquatic animal diseases also increases posing high risks to production. White spot syndrome virus (WSSV), was first noted in Asia beginning in the 1990s including 9 countries in the Americas as of 1999. Most recent outbreaks include that of Brazil (2005), the Kingdom of Saudi Arabia (2010-2011), Mozambique (2011), Brunei (2012), and Madagascar (2012) (Reantaso. 2013). How the disease pathogen transferred from one country to another is a lesson to learn and it is thought that import and export of live shrimp was a factor. This is supported by Huchzermeyer (2014).

The study revealed that in 83% and 80% of countries, farmers exchanged fingerlings and fishing gear respectively.

The management and control of diseases is a core Governmental responsibility that can be implemented with appropriate legislation and enforcement. Regulations on notification, diagnosis, epidemiology and restrictions to trade are important tool in disease management.

Eighty three percent of responding countries stated they had a Aquatic Animal Health Policy and 60% stated they had an aquatic animal disease reporting system in place. However, only 17% of responding countries stated they had aquatic animal disease diagnostic facilities. Member States are limited therefore in their capability to diagnose disease which may result into them taking inappropriate measures for disease control. Therefore, Member States are at risk of disease introduction and once outbreaks occur diseases are likely to spread very fast.

6. OVERVIEW OF AQUATIC ANIMAL DISEASE CONTROL IN THE REGION

6.1 Presence of National and Regional Aquatic Animal Disease Control Policies and Measures.

World aquaculture production continues to grow albeit at a slowing rate. Aquaculture across the eastern African Region is a modest industry, and at the present rate of development cannot cope with the expected strong increase in demand for fish and fish products. As aquaculture grows, chances that aquatic animal disease outbreak increase is higher. There is clear indication that disease incidences in the aquaculture and fisheries industry have the capacity of causing huge economic loss as occurred in Asian countries where massive expansion in aquaculture industry preceded fish health capabilities which cost the industry heavily (Reanatso 2002).

Disease outbreak has high consequences for aquaculture production and thus significant impacts on economy at the local, national and regional levels. Aquaculture production is vulnerable to adverse impacts of disease and environmental conditions. Management of disease emergencies is a core activity in the Governmental authority based on appropriate Legislations and their reinforcement. Regulations on notification, diagnosis, epidemiology and restrictions to trade as well as fallowing an disinfection are important for in disease management. All biosecurity measures must have legal basis.

Effective organization, financial capabilities and adequate human resources as well as competent diagnostic laboratories are also key elements for aquatic animal disease control. Countries might have policies and other legislations in place but if the latter are missing the possibility for effective disease control is difficult.

it is mentioned in paragraph above Sudan, Kenya, Rwanda, Tanzania and Uganda have policies and measures in place to address aquatic animal health issues whereas Burundi did not have any policy nor measures in place to control diseases in the event of incidence. All countries having policies, these policies are only part of the major policies of the country example, Tanzania Aquatic animal disease is part of Fisheries Regulations of 2009, section 33 and is part of the Animal Disease Act No. 17 of 2003 provided in section 60 (a-c).

6.2 Opportunities, Issues and Challenges for Aquatic Animal Disease Control in the Region

The study revealed several opportunities exist for the control of aquatic animal diseases as outlined by countries in the Region (Annex 4). These are

- Availability of Diagnostic laboratories;
  i. Infrastructure for research;
  ii. Availability of Competent Authorities (CA);
  iii. Opportunity for Laboratory Twinning;
  iv. Sagana Fish farm and Kiganjo trout hatchery can offer excellent facilities for these operations.

The issues that would need to be addressed to strengthen capacity for aquatic animal disease control are:

- Strong legislation against unauthorized and organized fish movements;
- Sensitizing of farmers on fish movements, Best Management Practices of fish farming and broodstock management to manage diseases;
- Certification of hatcheries and broodstock producers;
- Development of a comprehensive fish disease management plan;
- Human and infrastructure (laboratories and equipment) development;
- Investment in research;
- Training/capacity building;
- Establishing National & Regional Aquatic Health Plan/Strategy;
- Developing Aquatic Animal Health specific Legislations;
- Establishing a comprehensive National or Regional Biosecurity plan and management of aquatic animal movement;
- Setting up of State of the Art laboratories for disease diagnosis; and
- Setting up Quarantine facilities in all public and private hatchery facilities.

However, Member States in the Region identified the following challenges associated with Aquatic animal disease control:

- Risks from pollution;
  i. Future plans for preventive and control of aquatic animal diseases;
  ii. Increasing of fish farms leads to more risks in disease;
  iii. Establishing a comprehensive National & Regional Biosecurity plan;
  iv. Availability of Human resources;
  v. Availability of reference laboratories;
  vi. Inadequate capacity (knowledge & personnel);
  vii. Inadequate information and effective harmonization of aquatic animal health issues;
  viii. Porosity of borders for fisheries and aquaculture products inspection;
  ix. Lack of legislation;
  x. Low human and infrastructure capacities;
  xi. Lack of sensitization of farmers of the dangers of unauthorized and organized fish movements; and
  xii. Lack of certification of seed/brood stock producers.

7. CASE STUDY TANZANIA: AQUATIC ANIMAL DISEASE PATTERNS AND CONTROL MEASURES WITHIN COUNTRIES VISITED – STATUS AND COMPARATIVE ANALYSIS

7.1 An Overview of Aquaculture Production and Development in Tanzania

The 2014 per capita fish supply from Tanzania's capture fisheries is 8.2 kg/capita/year whereas FAO recommends per capita consumption rate of 17 kg/capita/year. 86% of Tanzania's capture fishery production is from inland waters and 14% from the marine environment. Aquaculture is a growing private sector lead industry that is gradually changing from a subsistence to commercialized industry.

In contrast to the inland States of Uganda, Rwanda, Burundi, Sudan and South Sudan, Tanzania's aquaculture opportunities include both mariculture in the Indian Ocean and fresh-water culture. Major farmed fresh water aquatic animal species. include *Oreochromis niloticus*, *Clarias gariepinus* and Rainbow trout (*Oncorhynchus mykiss*). Whereas, mariculture species include *Pinctada margaritifera*, *chanos chanos* (Milk fish), *Scylla serrata* (mud crabs) and seaweed.

7.2 Incidences, Prevalence and Disease Distribution Patterns

As in the other countries of the Region, most of the potential aquatic animal pathogens cited from the regional survey and literature are commensual organisms that are not listed as notifiable conditions for international trade. Some species of flukes (Platyhelminthes: *Trematoda*), such as *Gyrodactylus* spp., are ectoparasites of fish and can cause serious damage to cultured species (Hopla et al., 1994).

Annex 1C to provides an overview of the pathogen distribution in Tanzania of fish nematodes (25%), cestodes (19.6%), digenean (16.1%), crustacean (16.1%) and monogenean (10.7%), protozoa, bacteria.

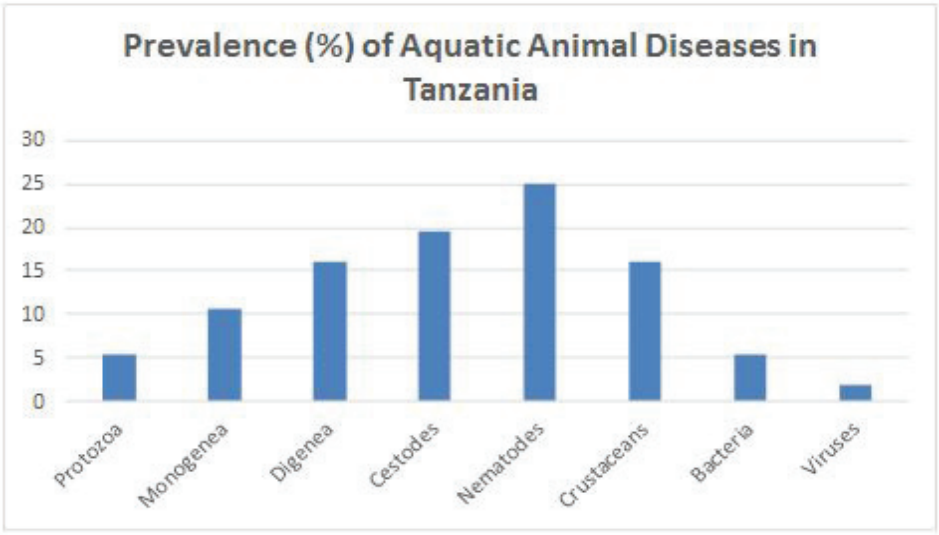


Figure 5: *Prevalence of Aquatic Animal Diseases in Tanzania*

7.3 Risk Factors and Determinants

Although although no notifiable aquatic animal disease outbreak has been reported to OIE from Tanzania, the current literature reviewed suggests the following factors are risks and determinant:

- Out sourcing fish broods stocks from wild waters;
  i. Presence of Vectors of some aquatic diseases (wild tilapines, copepods);
  ii. inability to establish quarantine facilities;
  iii. Aquaculture management systems (water quality control and intensification to a lesser extent presses stress to fish);
  iv. import or export genetic material between countries;
  v. exchange of genetic material among farmers;
  vi. inadequate policies and legislation specific for aquatic animal health; and
  vii. Floods.

7.4 Disease control Approaches.

There are limited measures available for disease control in the country although plans were made in 2015/2016 to undertake training of hatchery managers on the importance of setting biosecurity in the establishment, undertake Aphanomyces invadans active surveillance, and to prepare biosecurity plan for different farming systems. Tanzania has a good reporting system of aquatic animal diseases whereby information from the farmer reaches the department of Aquaculture and through the Aquatic animal health focal point (veterinarian) to the OIE delegate (Director of Veterinary Services) who in turn reports to the OIE. This reporting system is in line with the OIE recommendations (OIE 2014).

Tanzania Aquatic animal health issues is managed through available legislation and are implemented as part of Fisheries Regulations of 2009, section 33 and is part of the Animal Disease Act No. 17 of 2003 provided in section 60 (a-c).

7.5 Observations and Recommendations

The following are the observations and recommendations from the study:

a) Observations

i. Most fish farmers could not identify and manage fish diseases and parasites occurring in their farms or surrounding water environments;
ii. Tanzania has some advancement in terms of aquatic animal disease research next to Uganda as compared to other studied countries in the region although funding for research activities is inadequate;
iii. limited research activities in the field of aquatic animal health and therefore, most researchers concentrate their researches on other issues;
iv. There is limited capacity (human, financial and laboratory) to control aquatic diseases a situation which is also noted in other countries in the region;
v. There is limited link between research and extension/policy making agents as noted also in some of the reported countries where researchers reported a disease to occur in a given area but Director of Fisheries not informed.

b) Recommendations

i. Development and adoption of local, national and regional comprehensive biosecurity strategy for every farming system that are to be established in the Region;
ii. There is need to build the capacity of fish farmers, extension officers and policy makers to handle disease and parasite outbreaks;
iii. Increased cooperation among epidemiologists, fish scientists and farmers when evaluating causes and management of infectious diseases in aquaculture;
iv. There are needs to further follow up isolation of the identified pathogens and intensively characterize them to species level to exclude or declare outbreaks of a particular disease;
v. Concerted efforts to control aquatic diseases at national and regional levels will effectively avert risks diseases in East Africa;
vi. Strategies such as developing a national fish health diagnostic plan with enforceable regulatory framework;
vii. This Study should be part of a concerted effort to address transboundary issues related to aquatic animal health management in the African continent;
viii. Build capacity of stakeholders to manage and access basic fish pathology management skills;
ix. Develop participatory research that increases production and profitability;
x. Establish a tripartite link between Research-Extension-Farmer for faster and easy communication for feedback;
xi. Countries including Tanzania should develop a system for laboratory twinning;
xii. Adopt simple biosecurity measures that safeguards farmed and wild fish populations; and
xiii. Build a communication platform that responds to disease break outs.

8. A SITUATION ANALYSIS OF THE AQUATIC ANIMAL DISEASE STATUS IN THE REGION

8.1 The major aquatic animal diseases in the region and a general overview of the implications of their occurrence on production, fish consumption and trade

Criteria for listing

According to OIE (2014), aquatic animal diseases are listed basing on the criteria outlined in Chapter 1.2 article 1.2.2. OIE (2014) listed Aquatic animal diseases are under mentioned:

Fish diseases

1. Epizootic Haematopoietic Necrosis disease
2. Infection with *Aphanomyces invadans* (epizootic ulcerative syndrome)
3. Infection with *Gyrodactylus* oodland
4. Infection with HPR-deleted or HPR0 Infectious Salmon Anaemia Virus
5. Infection with Salmonid Alphavirus
6. Infectious Haematopoietic Necrosis
7. Koi Herpesvirus disease
8. Red sea bream Iridoviral disease
9. Spring viraemia of carp
10. Viral Haemorrhagic Septicaemia

Mollusc diseases

1. Infection with *Abalone herpesvirus*
2. Infection with *Bonamia exitiosa*
3. Infection with *Bonamia ostreae*
4. Infection with *Marteilia refringens*
5. Infection with *Perkinsus marinus*
6. Infection with *Perkinsus olseni*
7. Infection with *Xenohaliotis californiensis*

Crustacean diseases

1. Acute Hepatopancreatic Necrosis disease
2. Crayfish plague (*Aphanomyces astaci*)
3. Infection with Yellowhead virus
4. Infectious hypodermal and haematopoietic necrosis
5. Infectious myonecrosis
6. Necrotising hepatopancreatitis
7. Taura syndrome
8. White Spot disease
9. White Tail disease

Amphibians

1. Infection with *Batrachochytrium dendrobatidis*
2. Infection with ranavirus

Major aquatic animal diseases in the region are well noted in Annex 1 a-f and according to the study in the region, all diseases listed in the study countries are not in the OIE list (above) but they might be important to be included in the National list (Diseases that are important at national level). However, more studies are recommended to further characterize some of pathogen to species level to determine whether they belong to the OIE list and or if they have effect to trade for example isolation of *Gyrodactylus* sp. in Lake Victoria isolated in *Clarias alluaudi*, *C. gariepinus* and *C. werneri*. Taking into consideration that, *Gyrodactylus oodland* is a notifiable disease to the OIE (Aquatic Manual 2014). The study recommends further studies to characterize this parasite to clear doubts over the situation.

Aeromonas hydrophila is known of its infectivity exhibiting clinical signs in fish which include septicemia, ascitis, erosion, ulceration, detachment of scale and exophthalmia. Its outbreak is mostly associated with aquaculture intensification (David Huchzermeyer, 2014). In this study motile *Aeromonas hydrophila* was isolated in Fish farms in the Eastern and southern Tanzania without exhibiting any clinica signs. In Kenya, *Aeromonas hydrophila* was isolated in fish farms of Mombasa.

On the other hand *Edwardsiella tarda* which was isolated in Mombasa fish farms is a member of the Enterobacteriaceae family. The bacterium is a facultative anaerobic, small, motile, gram negative, straight rod with flagella. Edwardsiellosis by *Edwardsiella tarda*; have been isolated in reptiles, fish, amphibians and freshwater and integrated aquaculture. *Edwardsiella tarda* (now *E. Piscicida*) is a bacterium that can infect a number of animal species and also humans. Edwardsiellosis is one of the most serious systemic bacterial diseases in fish, resulting in substantial losses in the fish farming industry all over the world (FAO, 2006).

Infection of tilapia has been reported by a number of authors, causing chronic mortalities in Nile tilapia in some farms in Japan with integrated fish farming fertilized with pig manure. In humans, *Edwardsiella tarda* causes liver abscess, mild diarrhea or wound infection (FAO, 2006).

8.1.1 Endemic Diseases

Most of the information in this report resulted from literature review therefore, more work is required to reveal the current situation of diseases in respective countries to determine their endemicity. In this regard, it is difficult to decide whether a particular disease is endemic or not. Inadequate linkages between researchers, farmers and extension services/policy makers has resulted into misinformation on what is happening in the field. Thus ending up into researchers reporting on occurrence of a certain disease in a certain locality without coordinating/linking extension services/ policy makers whom would provide feed backs and therefore, fish farmers are not able to assess the

disease and come up with decision as whether the disease is endemic in the area or not.

8.1.2 Notifiable Diseases

The study in the region revealed that, all diseases listed in the Region are not in the OIE list but they might be important to be included in the National list (Diseases that are important at national level) except for *Gyrodactylus* sp. that is prevalent in Lake Victoria and shall require further characterization to determine whether or not the parasite is notifiable to OIE. If found to be notifiable, then the reported pathogens are notifiable at farm and national levels as reported by Kenya.

Some isolates examples: *Argulus* sp. isolated in Lake Victoria (Uganda), calls for further investigation to exclude other *Argulus* sp. that are potential pathogen in several countries affecting production.

8.1.3 Transboundary and Emerging Diseases

According to OIE, Transboundary animal diseases are defined as: "Those that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/management, including exclusion, requires cooperation between several countries. Such definition should include Emerging Infectious Diseases (EIDs), most of which will likely be zoonoses, but of uncertain impact".

Further studies are required to characterize the identified organisms thought to have some potentiality of being notifiable OIE. The study identified no emerging or Transboundary aquatic animal disease (s).

8.2 The Predisposition of the Occurrence of the Major Reported Diseases

8.2.1 Species Sanitary Maps

Aquatic animal species distribution which has impacts in disease epidemiology is an important aspect to consider when dealing with aquatic animal diseases. Some disease pathogens are host specific and can only affect certain or example, *Aphanomyces invadans* impacts more on *Clarius gariepinus* than Nile tilapia. The major farmed fish species in the region are *Oreochromis niloticus* and *Clarias gariepinus*. Other farmed aquatic animals include Milk fish (*chanos chanos*), mud crabs (*Scylla serrata*), Rainbow trout (*Oncorhynchus mykiss*) and *Pinctada margaritifera* which are cuturable sp. in Tanzania. Lates niloticus, *Clarius lazira* and *Labio* spp. in Sudan and *Cyprinus carpio*, *Tilapia zilli* and Mirror carp (*Cyprinus carpio*) in Uganda. The map below indicates aquatic animal species distribution in the region.

8.2.2 Spatial and Environmental Factors

Spatial factors in this context may be reflected in two ways, stocking density and space between farms. These two are very important disease determinants. Environmental factor as disease determinants are related to management practices especially management of water quality in which poor quality of water poses greater stress to the animals thus predisposing them to diseases. In this study, all countries under study indicated that they used recommend stocking densities based on species.

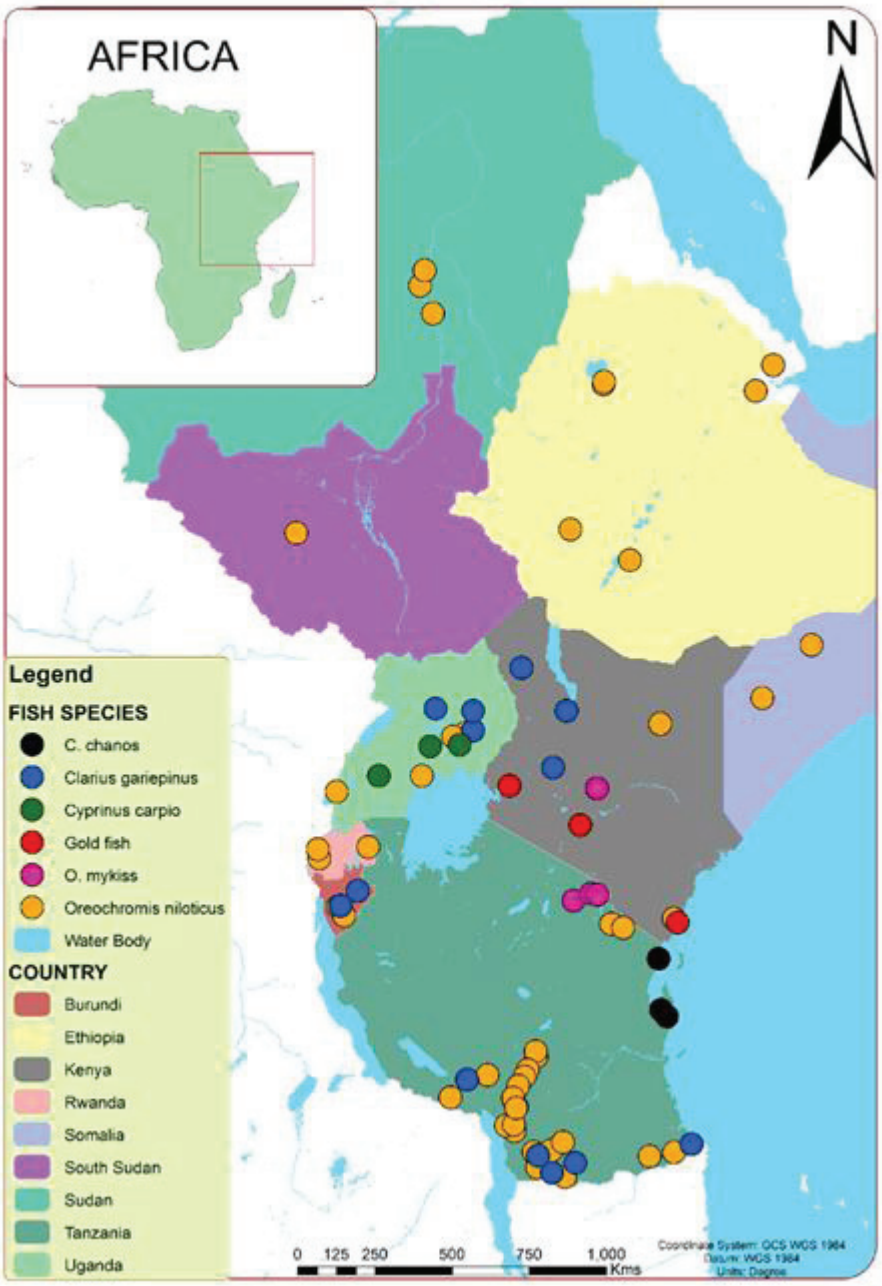


Figure 6: *Fish Species Sanitary Map*

8.2.3 Production Systems

Most of the East African Region aquaculture still managed through subsistence farming with typical extensive to semi-intensive aquaculture. Production system is one of the risk factor of diseases occurrence and spread in the area with intensive aquaculture the ring leading factor.

8.3 A General Overview/Analysis of the Status and Control of Aquatic Animal Diseases in the Region: Issues, Challenges, Recommendations.

From the study, aquatic animal diseases are not well surveyed a nor monitored making the assessment of their status. A number of issues need be to overcome to change the status quo.

Issues that require to be addressed include:

i. Strong legislation and its enforcement against unauthorized and organized fish movements;
ii. Sensitizing of farmers on fish movements, BMPs of fish farming and broodstock management;
iii. Certification of hatcheries and broodstock producers;

iv. Development of a comprehensive fish disease management plan;
v. Human and infrastructure (laboratories and equipment) development;
vi. Promotion and Investment in research;
vii. Training/capacity building;
viii. Establishing National & Regional Aquatic Health Plan/Strategy and specific Legislations;
ix. Establishing a comprehensive National & Regional Biosecurity plan;
x. AAH Certification for aquatic animal movement;
xi. Developing Quarantine facilities in all hatchery facilities;
xii. A lot of disease investigations need to be done in fish farms as shown in this report that 69.9% of the investigations on occurrence of aquatic animal disease pathogen were undertaken in natural waters and only 30.1% investigations were in fish farm;
xiii. Setting up of State of the Art laboratories for disease diagnosis; and
xiv. Setting up Quarantine facilities in all public and private hatchery facilities.

Challenges

The study identified the following as challenges for aquatic animal disease control in the region

i. Risks from pollution;
ii. Future plans for preventive and control of aquatic animal diseases;
iii. Increasing of fish farms leads to more risks in disease;
iv. Establishing a comprehensive National & Regional Biosecurity plan;
v. Availability of Human resources;
vi. Availability of reference laboratories;
vii. Inadequate capacity (knowledge & personnel);
viii. Inadequate information and effective harmonization;
ix. Porosity of borders;
x. Lack of legislation;
xi. Low human and infrastructure capacities;
xii. Lack of sensitization of farmers of the dangers of unauthorized and organized fish movements; and
xiii. Lack of certification of seed/brood stock producers.

Recommendations

i. Development and adoption of local, national and regional comprehensive biosecurity strategy in Africa for every farming system that are being established in the Region including strategies to report disease outbreaks to the relevant authorities;
ii. There is need to build the capacity of fish farmers, extension officers and policy makers to handle emergency disease and parasite outbreaks;
iii. Strengthen cooperation among epidemiologists, fish scientists and farmers when evaluating causes and management of infectious diseases in aquaculture;
iv. Member States should promote and adopt a community-based aquatic animal disease reporting system as that promoted in Djibouti in terrestrial animals. In this, member states should strengthen the recognition of aquatic animal diseases at community level through improving network among fish farming communities, aquatic animal health service providers and other stakeholders the main aim is to facilitate the supervision and control of aquatic animal diseases in the field and in the regions;

v. There are needs to further follow up isolation of the identified pathogens and intensively characterize them to species level to exclude or declare outbreaks of a particular disease as important or not important for reporting;
vi. Concerted efforts to control risks associated with disease outbreak and spreading examples minimize outsourcing broodstock from wild, controlled export and import of live aquatic animal species, strengthen and establishment of aquatic animal health certification system, farmers and stakeholder awareness on effects of exchange of unchecked genetic material in spreading diseases at national and regional levels tol effectively avert risks of diseases in region;
vii. Strategies such as developing a national fish health diagnostic plan with enforceable regulatory framework should be promoted;
viii. Build capacity of stakeholders to manage and access basic fish pathology management skills;
ix. Develop participatory research that increases production and profitability;
x. Establish a tripartite link between Research-Extension-Farmer for faster and easy communication for feedback;
xi. AU -IBAR strong recommend cooperation from its member states to respond to matters raised by this regional organization (members should respond to matters as raised by the AU-IBAR) that require implementation for the benefits of the member states and African region as a whole example some counties did not respond when AU-IBAR requested them to respond when gathering information on mapping study of aquatic anima diseases;
xii. Adopt simple biosecurity measures that safeguards farmed and wild fish populations; and
xiii. Build a communication platform that responds to disease break outs.

9. RECOMMENDATION AND OPINIONS FROM REGIONAL FISHERY BODIES (RFBs) AND REGIONAL ECONOMIC COMMUNITIES (RECs)

During the study, a total of fifteen Regional Fishery Bodies (RFBs) and Regional Economic Communities (RECs) were considered as potential sources of information gathering for Mapping study of Aquatic Animal Diseases in the region. List of contact persons and RFBs and RECs are in Annex 6. All countries, RFBs and RECs were given Questionnaire to fill in some important information (Annex 7). However, one Regional Fisheries Bodies (Lake Victoria Fisheries Organization) out of 15 responded to the questionnaire.

The Lake Victoria Fisheries Organization (LVFO) noted that, capture fisheries production is fluctuating and that, the organization considers Aquatic Animal Diseases is one of the issues which need to be addressed.

However, the LVFO identified several issues need to be addressed by the Organization in order to undertake effective Aquatic Animal disease control to its Member States. These are,
i. Coordinated Institutional arrangements where research laboratories/institutions dealing with fish diseases should be identified and accredited and build capacity regionally;
ii. Harmonized Legal Instruments – need of harmonized policies on movement of seeds and how to ensure and control quality from one Partner State to another;
iii. Awareness creation/extension services to fish farms on how to identify and contain such diseases;
iv. Capacity building issues at farm level as well as for Government Extension staff; and
v. Provision of regional forum annually to bring different key stakeholders to discuss and share experience.

On the other side, LVFO is facing challenges in imposing Aquatic Animal Disease Control strategies in the region and this is, LVFO being a regional body works through the existing structures in the Partner Sates and so far animal diseases including fish diseases are vested with the Veterinary services which are under Livestock Ministries/departments. LVFO Institutions are the ones responsible for fisheries and aquaculture in Partner States and therefore it is not directly related to livestock/ veterinary services. Therefore, need to establish the institutional linkages at regional level especially as Aquaculture development is now one of the core focus of the organization.

Despite the challenges, there exist some opportunities for Aquatic Animal Disease Control in the Member States that the organization is seeing and these are:

i. With the mandate of the organization to coordinate the management and development of fisheries and aquaculture and being a technical arm of the EAC in those matters, it is at a strategic position of bringing the technical teams together at regional level to harmonize policy and technical issues on animal diseases control; share knowledge and disseminate to stakeholders verified information;
ii. At regional level, such findings can also be regional packaged and disseminated;
iii. At regional level, accreditation criteria and identification of service providers can also be done in a harmonized agreed procedure; and
iv. There is also an opportunity to put together a database which can be regionally updated and shared.

The LVFO had has no Aquatic Animal Disease Control Policies, Legislation and strategic Measures for handling Aquatic Animal Disease issues in its Member States which poses a bigger risk to the fisheries and aquaculture The Organization though, Organization has future plans/strategies to establish and develop Aquatic Animal Disease Control Policies, Legislation and strategic measures for the Member States.

Currently, the Organization is developing a policy for fisheries and Aquaculture in EAC in which diseases issues shall be addressed. With the approval of that policy, the Organization proposes to have an Aquaculture Regional Working Group that will work closely with the Veterinary Experts and Research centers and Laboratories to develop the policies, legislations and strategies. Currently are being finalized. Guidelines and Standard Operating Procedures (SOPs) for Cage Culture on Lake Victoria Veterinary Expert are now being involved in technical consultations at Partner State and regional level.

This study was interested to know if the organization have capacity to facilitate its Member States to undertake Aquatic Animal Disease surveillance, diagnosis and diseases Risk analysis and their opinion was that, the LVFO Institutional structures at Partner State level are yet to fully incorporate that sector, but with the focus to develop aquaculture and specifically commercial aquaculture, that is an area which require institutional and human capacity development.

On the aspect of situation analysis/overview of prevalence and incidences of aquatic animal diseases in the country, member states were not reporting aquatic animal diseases to the organization realizes the implications of disease outbreak on production, fish consumption and trade. The LVFO realized that:

i. Aquatic Animal Diseases; fish diseases have been handled largely as an academic discipline within the research institutions of LVFO The approach now is to undertake aquatic animal disease control as a specific program area under the Aquaculture
ii. In capture fishery. Assuming disease outbreak in cage farming the regional and export trade on Nile perch could also severely be affected especially if a ban in export would be instituted.

The organization has no contingency plan to overcome in case of Aquatic Animal Disease outbreak in the member States. However, the organization consider that, the systems put in place are more for Sanitary and Phyto-sanitary. Each Partner State has Fish Quality Laboratories and a system in place to collect samples on agreed regular basis to monitor quality sample Sediment, water and fish samples to <are taken regularly. Also all the exports of fish products have to be inspected and certified before any consignments are exported out of the country of origin.

The Lake Victoria Fisheries Organization recommends that, with the development of aquaculture, fish diseases will become an obvious threat and therefore a system as that of quality control as explained above would have to be put in place.

REFERENCES

1. ACP Fish II, 2013. Analytical Review of Private Sector Involvement in Aquaculture in EAC Partner States, With Recommendations for Future Areas of Growth and Support.
2. Aloo, P. A. 2002. A comparative study of helminth parasites from the fish Tilapia zillii and Oreochromis leucostictus in Lake Naivasha and Oloidien Bay, Kenya. Journal of Helminthology 76(2): 95-102.
3. Ammar O. E et al. 2016. Country responses to Checklist/Questionnaire for Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries – Sudan.
4. Arjo Rothuis, Mike Turenhout, Arie van Duijn, Arjen Roem, Eugene Rurangwa, Egid Katunzi, Amon Shoko and Jean Bosco Kabagambe, 2014. Aquaculture in East Africa A regional approach. Adding value to the East-African aquaculture sector.
5. Arjo Rothuis, et al., 2014. Aquaculture in East Africa. A regional approach.
6. AU-IBAR, 2015. National Workshop report for Creating a Disease Declaration System for Community Based Djibouti.
7. AU – IBAR 2014. Technical Report of a Workshop On Trade and improved livelihoods in aquatic production in Africa (TILAPIA) Building capacity on fish health and aquatic biosecurity to sustain and develop aquaculture and fisheries in Africa.
8. Chacha J. Mwita. 2014. Metazoan Parasites of Clariid Fishes, Lake Victoria: Reflection of the Original Fauna in the Lake?
9. Hopla, C.E., L. A. Durden and J. E. Keirans, 1994. Ectoparasites and classification.
10. C. Mwita and G. Nkwengulila. 2009. Parasites of CLARIUS GARIEPINUS (BURCHELL, 1822) (PISCES: CLARIIDAE) FROM THE MWANZA GULF, LAKE VICTORIA.
11. David Huchzermeyer, 2014. Lecture notes on Biosecurity, Risk and Health Management.
12. FAO, 2014. The State of World Fisheries and Aquaculture.
13. FAO, 2012 World review of fisheries and aquaculture.
14. FAO, 2008. Fisheries Country Profile – SUDAN.
15. FAO, 2006. Antimicrobial Use in Aquaculture and Antimicrobial Resistance. Report of a Joint FAO/OIE/WHO Expert Consultation on Antimicrobial Use in Aquaculture and Antimicrobial Resistance.
16. FAO, 2002. A Review of The Economic Impacts of Aquatic Animal Disease.
17. FAO, 1996. Parasites, infections and diseases of fishes in Africa: An update 1996.
18. Hamisi L Nikuli, 2016. Country responses to Checklist/Questionnaire for Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries - Tanzania.
19. Hamisi L. Nikuli, Syed Q. A. Shah, Duncan J. Colquhoun, and Henning Sørum. 2012. Prevalence of Antibiotic Resistance Genes in the Bacterial Flora of Integrated Fish Farming Environments of Pakistan and Tanzania.
20. IFOAM 2013. Report on Scoping Study on Organic Aquaculture in 5 East African Countries.
21. Kamel E. A., 2001. Characterization of tilapia species (lecture). A training program on: Improving fish farm management. oodland e by ICLARM- The World fish centre and the multi sector support program, MSSP, of European community, Abassa, Egypt, 20-24 F ebruary 2001.
22. KAREGA Déogratias, 2016. Country responses to Checklist/Questionnaire For Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries – Burundi.
23. Mai D. Ibrahem, M. M. Mostafa, R. M. H. Arab And M. A. Rezk, 2008. Prevalence Of Aeromonas Hydrophila Infection In Wild And Cultured Tilapia Nilotica (O.Niloticus) In Egypt.

24. Maarten P. M. Vanhove, et al., 2011. Ancyrocephalidae (Monogenea) of Lake Tanganyika: I: Four new species of Cichlidogyrus from Ophthalmotilapia ventralis (Teleostei: Cichlidae), the first record of this parasite family in the basin.
25. Mdegela RH;, Msuya CP;, Mbuthia PG;, Byarugaba DK. "Prevalence of Amirthalingamia macracantha and Trypanosomosis in Oreochromis niloticus in Lake Victoria in Mwanza Tanzania."; 2010.
26. Reantaso, M. 2013. Presentation in Developing Strategy for Improving Biosecurity (Aquatic Animal Health) in the Sub-regional Countries of the Mozambique Channel (Madagascar, Mozambique and Tanzania) (Unpublished).
27. Reantaso, M. 2002. Trans-boundary aquatic animal diseases: Focus on Koi herpes virus (KHV).
28. Mwanja, et al. 2016. Country responses to Checklist/Questionnaire For Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries – Uganda.
29. OIE 2014. Aquatic Animal Health Code.
30. P. Akoll, W.W. Mwanja, K. Robert, Juliet Kigongo Nattabi, Catherine Agoe and Fritz Schiemer. 2011. Parasite fauna of farmed Nile tilapia (Oreochromis niloticus) and African catfish (Clarias gariepinus) in Uganda.
31. Research Proposal 2008, Sudan University of Science and Technology Scientific Research Council.
32. Dadzie, S. 1992. An overview of aquaculture in eastern Africa.
33. Wilson, Rutaganira 2016. Country responses to Checklist/Questionnaire For Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries - Rwanda.
34. Walakira, J. et al., 2014 Common fish diseases and parasites affecting wild and farmed
35. Tilapia and catfish in Central and Western Uganda.
36. Gichuri, W. M. 2016. Country responses to Checklist/Questionnaire for Mapping Study of Aquatic Animal Diseases In Eastern Africa and IGAD Countries - Kenya.

ANNEX 1A: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION – UGANDA

NAME OF THE DISEASE	INFESTED HOST	LOCATION/ COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
PROTOZOA *Apiosoma sp.*	*Clarias gariepinus*	Fish farms, Uganda	P Akoll and WW Mwanja. (2012)
Babesiosoma mariae	*Astatoreochr Labeo ianus, Oreochromis O. niloticus,*	Lake Victoria, Uganda	*P Akoll and WW Mwanja. (2012)*
Chilodonella sp.	*Oreochromis variabilis*	Lake Victoria, Uganda	Akoll et al. (2012)
Ichthyophthirius multifiliis	*Oreochromis niloticus*	Fish ponds, cages and reservoirs in Uganda	P Akoll and WW Mwanja. (2012)
Goussia cichlidarum	*Oreochromis niloticus, Sarotherodon galilaeus*	*Lakes George and Victoria, Uganda*	P Akoll and WW Mwanja. (2012)
Epistylis sp.	*Clarias gariepinus*	Fish farms, Uganda	Akoll et al. (2012)
Ichthyobodo sp.	*Oreochromis niloticus*	Fish ponds, cages and reservoirs in Uganda .	Florio et al. (2009)
Ichthyophthirius multifiliis	*Barbus paludinosus, Lebistes*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012)
Myxobolus brachysporus	*Oreochromis esculentus, O. variabilis, oodland es, Oreochromis niloticus*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012)
Myxobolus heterosporus	*Haplochromis sp., Oreochromis eculentus, O. niloticus, O. variabilis*	Lakes George and Victoria, Uganda	P Akoll and WW Mwanja. (2012)
Myxobolus homeospora	*Oreochromis esculentus, O. variabilis Oreochromis niloticus, O. variabilis, Sarotherodon galilaeus, Tilapia zillii*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012)
Myxobolus kainjiae	*Haplochromis angustifrons, H. elegans*	Lake George, Uganda	P Akoll and WW Mwanja. (2012)
Myxobolus stenosus	*Synodontis schall*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012)
Plistophora sp.	*Haplochromis angustifrons, H. elegans*	Lake George, Uganda	P Akoll and WW Mwanja. (2012)
Sphaerospora sp.	*Oreochromis niloticus*	Fish ponds and reservoirs, Uganda	P Akoll and WW Mwanja. (2012)
Trichodina spp.	*Clarias gariepinus, Oreochromis niloticus*	Fish ponds and reservoirs, Uganda.	Akoll et al. (2012), Florio et al. (2009)
Amirthalingamia macracantha	*Clarias gariepinus, Oreochromis niloticus*	Hatcheries, grow out ponds, reservoir, cages, fishponds and a stream. Uganda	Akoll et al. (2012)
Trichodinella spp.	*Clarias gariepinus Oreochromis niloticus*	Reservoirs, Uganda	P Akoll and WW Mwanja. (2012)
Trypanosoma mariae	*Astatoreochromis alluaudi, Lcto*	uganda	P Akoll and WW Mwanja. (2012)
Trypanosoma mukasai	*O. variabilis*	Lakes George and Victoria, Uganda	P Akoll and WW Mwanja. (2012)

NAME OF THE DISEASE	INFESTED HOST	LOCATION/ COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
MONOGENEA			
Annulotrema elongata	*Alestes baremoze*	Uganda	P Akoll and WW Mwanja. (2012)
Annulotrema gravis	*Brycinus nurse*	Uganda	P Akoll and WW Mwanja. (2012)
Characidotrema oodland	*Brycinus nurse*	Uganda	P Akoll and WW Mwanja. (2012)
Cichlidogyrus dionchus	*Haplochromis guiarti*	Lake Victoria, Uganda	Maarten P. M. Vanhove et al., 2011
Cichlidogyrus arthracanthus	*Tilapia zillii*	*Uganda*	*P Akoll and WW Mwanja. (2012)*
Cichlidogyrus halli	*Oreochromis leucostictus, O. niloticus, Sarotherodon galilaeus*	Lakes George and Albert and Kajjansi fish farm, Uganda	Maarten P. M. Vanhove et al., 2011
Cichlidogyrus haplochromii	*Haplochromis spp., Oreochromis leucostictus, Tilapia sp.*	Lakes Albert, Victoria, George, Nabugabo, Bunyoni and Mulehe, Uganda.	Maarten P. M. Vanhove et al., 2011
Cichlidogyrus longipenis	*Astatoreochromis*		
alluaudi	*Lake Victoria, Uganda*	Maarten P. M. Vanhove et al., 2011	
Cichlidogyrus thurstonae	*Oreochromis esculentus, O. niloticus, O. variabilis, Haplochromis longirostris*	Uganda	Maarten P. M. Vanhove et al., 2011
Cichlidogyrus sclerosus	*Oreochromis niloticus*	Kajjansi fish ponds, reservoirs, Uganda.	Akoll et al. (2012), Florio et al. (2009)
Cichlidogyrus sclerosus	*Haplochromis sp.,Oreochromis leucostictus, O. mossambicus, O. niloticus, Tilapia zillii*	Lakes George and Victoria, Kajjansi fish ponds, Uganda	Maarten P. M. Vanhove et al., 2011
Cichlidogyrus tilapiae	*Oreochromis niloticus*	Kajjansi fish ponds, reservoirs, Uganda.	Akoll et al. (2012), Florio et al. (2009)
Cichlidogyrus tilapiae	*Haplochromis macrognathus, Oreochromis leucostictus, O. mossambicus, O. niloticus, Tilapia zillii*	Lakes George and Victoria, Kajjansi fish farm, Uganda	Maarten P. M. Vanhove et al., 2011
Diplectanum lacustris	*Khalil (19 Lates niloticus*	Lake Albert, Uganda	Maarten P. M. Vanhove et al., 2011
Diplectanum lacustris do	*Lates niloticus*	Uganda	Maarten P. M. Vanhove et al., 2011
Macrogyrodactylus congolensis	*Clarias gariepinus*	Fish farms in Uganda	Akoll et al. (2012)
Neodactylogrus spinicirrus	*Barbus altinalis*	Uganda	P Akoll and WW Mwanja. (2012)
Neodiplozoon polycotyleus	*Barbus neumayeri*	Intermittent stream in Kibale Forest, Uganda	*P Akoll and WW Mwanja. (2012)*

NAME OF THE DISEASE	INFESTED HOST	LOCATION/ COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
Schilbetrema acornis	*Schilbe mystus*	Uganda	P Akoll and WW Mwanja. (2012)
Schilbetrema quadricornis schilbe	*Schilbe mystus*	Uganda	P Akoll and WW Mwanja. (2012)
Scutogyrus gravivaginus	*Oreochromis leucostictus, O. variabilis*	Lakes Victoria and Albert, Uganda	Maarten P. M. Vanhove et al., 2011
Quadriacanthus clariadis	*Bagrus docmac, Clarias*	Uganda	P Akoll and WW Mwanja. (2012)
Scutogyrus gravivaginus	*Oreochromis leucostictus,*	Lakes Victoria and Albert, Uganda	Maarten P. M. Vanhove et al., 2011
Scutogyrus longicornis	*Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zillii*	Lakes George and Albert, Uganda	Maarten P. M. Vanhove et al., 2011
DIGENEA			
Bolbophorus sp.	Oreochromis niloticus	Lake Victoria, Tanzania Lake Victoria, reservoirs and fish ponds, Lake Uganda	Akoll et al. (2012), Paperna (1996)
Clinostomum cutaneum	*Oreochromis niloticus*	Reservoirs and fish ponds in Uganda	Akoll et al. (2012), Florio et al. (2009), Gustinelli et al. (2010)
Clinostomum phalacrocoracis	*Oreochromis niloticus*	Reservoirs and fish ponds in Uganda	P Akoll and WW Mwanja. (2012)
Euclinostomum heterostomum	*O. niloticus*	Reservoirs in Uganda	P Akoll and WW Mwanja. (2012)
Heterochis crumenifer (syn. Distoma protopterii)	*Protopterus aethiopicus*	Uganda	P Akoll and WW Mwanja. (2012)
Neascus sp.	Oreochromis niloticus	Lake Victoria	P Akoll and WW Mwanja. (2012)
Ornithodiplostomum sp.	Clarias gariepinus	Fish ponds, Uganda	Akoll et al. (2012)
Zoogonoides sp.	*Clarias gariepinus*	Fish ponds, Uganda	Akoll et al. (2012)
CESTODA			
Amirthalingamia macracantha	*Oreochromis niloticus*	Reservoirs and fish ponds in Uganda	Akoll et al. (2012), Florio et al. (2009)
Amphilinidae	Clarias gariepinus	Fish ponds, Uganda	Akoll et al. (2012)
Ligula intestinalis	*Barbus spp., Haplochromis spp, Rastrineobola argentea*	Lake Victoria, Uganda	Paperna (1996) P Akoll and WW Mwanja. (2012).
Monobothrioides sp.	Clarias gariepinus	Fish ponds , Uganda	Akoll et al. (2012)
NEMATODES			
Contracaecum larvae	*Oreochromis niloticus*	Lake George, Uganda	P Akoll and WW Mwanja. (2012)
Contracaecum larvae	*Clarias gariepinus*	Fish ponds Uganda	Akoll et al. (2012)
Eustrongylides sp.	*Bagrus docmac*	Lake Victoria, Uganda	FAO, (1996).
Eustrongylides sp.	*Haplochromis spp.*	Lake Victoria, Uganda	FAO, (1996).
Procamallanus sp.	*Clarias gariepinus, Oreochromis niloticus*	Fish ponds Uganda	Akoll et al. (2012
Spinitectus thrustonae	Mormyrus sp.	Uganda	FAO, (1996).

NAME OF THE DISEASE	INFESTED HOST	LOCATION/ COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
ACANTHOCEPHAL A			
Acanthogyrus tilapiae	*Oreochromis niloticus*	Reservoirs and fish ponds in Uganda	Akoll et al. (2012), Florio et al. (2009)
CRUSTACEA (Branchiura)	*Bagrus docmac,* Argulus africanus Barbus altianalis, C. gariepinus, Haplochromis spp., O. esculentus, O. variabilis, Protopterus aethiopicus	*Lake Victoria Uganda*	P Akoll and WW Mwanja. (2012).
Argulus cunningtoni	*Auchenoglanis occidentalis,* Bagrus bayad, Clarias gariepinus, Distichodus niloticus, Lates niloticus, Synodontis schall	*Lake Albert, Uganda*	P Akoll and WW Mwanja. (2012).
Argulus rhipidiophorus	*Haplochromis sp., Oreochromis niloticus*	Lake Edward and Kazinga Channel, Uganda	P Akoll and WW Mwanja. (2012).
Argulus rhipidiophorus	*Alestes baremoze, Bagrus bayad, Clarias gariepinus, Hydrocynus forskahlii, H. lineatus, L. niloticus*	Lake Albert, Uganda	P Akoll and WW Mwanja. (2012).
Chonopeltis brevis	*Barbus altianalis radcliffi,* Labeo victorianus	*Lake Victoria, Uganda.*	P Akoll and WW Mwanja. (2012).
CRUSTACEA (Copepoda)	Ergasilus lamellifer Haplochromis sp.	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012).
Lamproglena barbicola	*Barbus altianalis radcliffi*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012).
Lamproglena clariae	*Clarias gariepinus*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012).
Lamproglena monody	*Haplochromis spp., Oreochromis* esculentus, O. variabilis,	*Lake Victoria, Uganda*	P Akoll and WW Mwanja. (2012).
Lernaea barnimiana	Lates niloticus Barbus altianalis radcliffi, Labeo victorianus, Oreochromis esculentus, O. variabilis	Lake George, Uganda Lake Victoria, Uganda	*P Akoll and WW Mwanja. (2012).*
Lernaea cyprinacea	*Bagrus docmac, Oreochromis*		
esculentus, O. variabilis	*Lake Victoria, Uganda*	P Akoll and WW Mwanja. (2012).	
Lernaea oodlan	*Rastrineobola argentea*	Lake Victoria, Uganda	P Akoll and WW Mwanja. (2012).
Opistholernaea laterobrachialis niloticus	*Oreochromis niloticus Opistholernaea longa*	Nile system	P Akoll and WW Mwanja. (2012).
BACTERIA			
Chlamydiales bacteria	Clarias gariepinus	Fish farms, Uganda	Akoll (2005)
FUNGUS			
Saprolegnia sp.	Oreochromis spp.	Uganda	Paperna (1996) P Akoll and WW Mwanja. (2012).

NAME OF THE DISEASE	INFESTED HOST	LOCATION/ COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
VIRUSES			
Lymphocystis virus	*Haplochromis sp., Oreochromis variabilis*	*Lake Victoria, Uganda*	P Akoll and WW Mwanja. (2012).
Lymphocystis virus	*Haplochromis sp., H. elegans, Oreochromis variabilis*	Lake George, Uganda	P Akoll and WW Mwanja. (2012).

ANNEX 1B: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION – KENYA

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	PROTOZOA			
	Coccidia sp	Oreochromis niloticus	Reservoirs and Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	Cryptobia sp.	Oreochromis niloticus	Reservoirs and Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	Ichthyophthirius multifiliis	Oreochromis niloticus	Fish ponds, cages and reservoirs in Kenya; Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	Ichthyobodo sp.	*Oreochromis niloticus*	Fish ponds, cages and reservoirs in Kenya; Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	Sphaerospora sp.	Oreochromis niloticus	Fish ponds and reservoirs, in Kenya	P Akoll and WW Mwanja. (2012)
	Trichodina spp.	Clarias gariepinus, Oreochromis niloticus	Fish ponds and reservoirs, and Sagana fish farm, Kenya	Akoll et al. (2012), Florio et al. (2009)
	Trichodina spp.	Oncorhyncus mykiss	Trout farm, slopes of Mount Kenya	Akoll et al. (2012).
	Trichodinella spp.	Clarias Gariepinus Oreochromi niloticus	Reservoirs in Kenya	P Akoll and WW Mwanja. (2012)
	MONOGENEA			
	Cichlidogyrus sclerosus	Oreochromis *niloticus*	*reservoirsand Sagana fish farm, Kenya*	Akoll et al. (2012), Florio et al. (2009)
	Cichlidogyrus tilapiae	*Oreochromis niloticus*	reservoirs, Sagana fish farm, Kenya	Akoll et al. (2012), Florio et al. (2009)
	Gyrodactylus sp.	Tilapia sp.	Intensive fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	DIGENEA			
	Clinostomum cutaneum	Oreochromis niloticus	reservoirs and Sagana fish farm, Kenya	Akoll et al. (2012), Florio et al. (2009), Gustinelli et al. (2010)
	Clinostomum phalacrocoracis	Oreochromis niloticus	reservoirs and Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)
	Euclinostomum heterostomum	O. niloticus	Reservoirs in Kenya; Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	CESTODES			
	Amirthalingamia macracantha	Oreochromis niloticus	Reservoirs and fish ponds in Kenya	Akoll et al. (2012).
	Amirthalingamia macracantha	Tilapia zillii	Lake Naivasha, Kenya	Aloo (2002)
	Ligula intestinalis	Barbus spp., Haplochromis spp, Rastrineobola argentea	Lake Victoria in Kenya	Paperna (1996) FAO, 1996
	NEMATODES			
	Afrophilometra hydrocyoni	Hydrocynus forskahlii	Lake Turkana, Kenya	Moravec et al. (2009b)
	Contracaecum larvae	Tilapia leucostictus	Lake Naivasha, Kenya	Aloo (2002)
	Contracaecum larvae	Oreochromis niloticus	Lake Baringo, Kenya.	FAO, 1996
	Contracaecum larvae	Alcolapia grahami	Lake Magadi, Kenya	FAO, 1996
	Contracaecum larvae	*Oreochromis leucostictus C. gariepinus*	Lake Naivasha, Kenya	Aloo (2002)
	Mexiconema africanum	Auchenoglanis occidentalis	Lake Turkana Kenya	Moravec et al. (2009a)
	Philometra bagri	Bagrus bayad	Lake Turkana, Kenya	Moravec et al. (2009b)
	Philometra lati	Lates niloticus	Lake Turkana, Kenya	Moravec et al. (2009b)
	Philometra spiriformis	Lates niloticus	Lake Turkana, Kenya	Moravec et al. (2009b)
	ACANTHOCEPHALA			
	Acanthogyrus tilapiae	Oreochromis niloticus	Reservoirs and fish ponds in Kenya	Akoll et al. (2012), Florio et al. (2009)
	Acanthogyrus tilapiae	Oreochromis niloticus, Tilapia zillii	Lake Naivasha, Kenya	Aloo (2002)
	Polyacanthorhynchus kenyensis	Micropterus salmoides, Oreochromis niloticus, Tilapia zillii, Tilapia sp.	Lake Naivasha Kenya	Aloo (2002)
	CRUSTACEA (Branchiura)			
	Argulus rhipidiophorus	Clarias gariepinus	Lakes Turkana (Rudolf) and Naivasha, Kenya	P Akoll and WW Mwanja. (2012)
	Chonopeltis brevis	Barbus Altianalis, radcliffi, Labeo victorianus	Lake Victoria, River Tana, Kenya.	P Akoll and WW Mwanja. (2012)
	CRUSTACEA (Copepoda)			

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	Ergasilus lates	*Oreochromis niloticus, Sarotherodon galileus*	Lake Turkana (Rudolf), Kenya	P Akoll and WW Mwanja. (2012)
	Lernaea longa	*Lates niloticus*	*Lake Turkana (Rudolf), Kenya*	P Akoll and WW Mwanja. (2012)
	BACTERIA			
	Aeromonas caviae	*Oncorhyncus mykiss*	Trout farm, slopes of Mount Kenya	P Akoll and WW Mwanja. (2012)
	Aeromonas hydrophila	*Oreochromis niloticus*	Fish farm in Mombasa, Kenya	FAO, 1996
		Oncorhyncus mykiss	Trout farm, slopes of Mount Kenya	P Akoll and WW Mwanja. (2012)
	Edwardsiella tarda	*Oreochromis niloticus*	Fish farm in Mombasa, Kenya	FAO, 1996
	Flavobacterium columnare	*Oreochromis niloticus*	Fish farm, Kenya	FAO, 1996
	Mycobacterium fortuitum	*Oreochromis niloticus*	Fish farm, Kenya	FAO, 1996
	FUNGUS			
	Aspergillus sp.	*Sarotherodon spp.*	Fish farm in Mombasa, Kenya	P Akoll and WW Mwanja. (2012)
	Branchiomyces sp.	*Oreochromis niloticus*	Sagana fish farm, Kenya	P Akoll and WW Mwanja. (2012)

ANNEX 1C: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION – TANZANIA

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	Trypanosome sp,.	*O. niloticus*	Lake Victoria – Tanzania	Mdegela RH, etal., 2010
	Amirthalingamia macracantha	*Oreochromis niloticus*	Lake Victoria – Tanzania	Mdegela RH, etal., 2010
	Trichodina sp.	*Oreochromis niloticus*	Mindu dam	FAO. (1996)
	MONOGENEA			
	Ancyrocephalus synodontii	*Synodontis victoriae*	Lake Tanganyika, Tanzania	M.P.Vanhove, et al., 2011.
	Cichlidogyrus haplochromii	*Haplochromis spp., Oreochromis leucostictus, Tilapia sp.*	Ruaha River, Tanzania	*Pariselle and Euzet (2009)*
	Gyrodactylus sp.	*Clarias alluaudi, C. gariepinus, C. werneri*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Cichlidogyrus vandekerkhovei	*O. ventralis*	Lake Tanganyika, Tanzania	Pariselle and Euzet (2009)
	Cichlidogyrus vandekerkhove	*O. ventralis*	Lake Tanganyika, Tanzania	Pariselle and Euzet (2009)
	C. makasai	*O. ventralis*	Lake Tanganyika, Tanzania	Pariselle and Euzet (2009)
	DIGENEA			
	Allocredium mazoensis	*Bagrus docmac, Clarias alluaudi, C. gariepinus, C. liocephalus, C. werneri*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	Astiotrema reniferum	*Clarias gariepinus, C. liocephalus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Cladocystis tanganyikae	Unidentified cichlid	Lake Tanganyika	Khalil (1971)
	Clinostomum sp.	*Clarias alluaudi, C. gariepinus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Diplostomum mashonense	*Clarias gariepinus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Euclinostomum heterostomum	*Clarias liocephalus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Eumasenia bangweulensis	*Bagrus docmac, Clarias*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Phyllodistomum folium	Bagrus docmac	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Tylodelphys spp.	Clarias gariepinus	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	CESTODE			
	Caryophyllaeus leticeps	Barbus tropidolepis	Tanzania	FAO. 1996
	Lytocestoides tangayikae	Alestes sp.	Tanzania	P Akoll and WW Mwanja. (2012)
	Marsypocephalus tanganyikae	Clarias lazera	Tanzania	FAO. 1996
	Monobothrioides cunningtoni	Auchenoglanis occidentalis	Tanzania	P Akoll and WW Mwanja. (2012)
	Monobothrioides oodland	*Clarias gariepinus,* C. liocephalus, C. werneri	*Lake Victoria, Tanzania*	Mwita and Nkwengulila (2008)
	Polyonchobothrium clarias	Clarias gariepinus, C. liocephalus, C. liocephalus, C. werneri,	*Lake Victoria Tanzania*	*Mwita and Nkwengulila (2008)*
	Amirthalingamia macracantha	*Oreochromis niloticus*	Lake Victoria Tanzania	Mdegela HR et al., (2010)
	Proteocephalus beauchampi	*Chrysichthys brachynema*	Tanzania	FAO. 1996
	Proteocephalus cunningtoni	*Dinotopterus cunningtoni*	*Tanzania*	*FAO. 1996*
	Proteocephalus dinotopteri	Dinotopterus cunningtoni	Tanzania	P Akoll and WW Mwanja. (2012)
	Proteocephalus sp.	Clarias gariepinus, Heterobranchus longifilis	Lake Victoria and Malagarasi River, Tanzania	Mwita and Nkwengulila (2008)
	NEMATODES			
	Camallanus kirandensis	Barbus sp.	Tanzania	Aloo, PA. (2002)
	Comephoronema sp.	Clarias liocephalus	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Contracaecum larvae	*Clarias alluaudi, C. liocephalus, C. werneri, Heterobranchus longifilis.*	Lake Victoria and Malagarasi swamp, Tanzania	Aloo, PA. (2002)

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	Dujardinascaris helicina	*Lates microlepis*	Tanzania	Aloo, PA. (2002)
	Eustrongylides sp.	*Dinotopterus cunningtoni, Oreochromis niloticus*	*Tanzania*	P Akoll and WW Mwanja. (2012)
	Gendria tilapiae	*Clarias gariepinus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Neogoezia sp.	*Clarias alluaudi, C. liocephalus, C. werneri*	*Lake Victoria, Tanzania*	Mwita and Nkwengulila (2008)
	Procamallanus laevionchus	*Clarias alluaudi, C. gariepinus, C. werneri, C. liocephalus*	*Lake Victoria, Tanzania*	Mwita and Nkwengulila (2008)
	Rhabdochona congolensis	*Clarias gariepinus*	*Lake Victoria, Tanzania*	*Mwita and Nkwengulila (2008)*
	Quimperia sp.	*Bagrus docmac, Clarias liocephalus, Heterobranchus longifilis*	Lake Victoria and Malagarasi River, Tanzania	Mwita and Nkwengulila (2008)
	Rhabdochona congolensis	*Clarias gariepinus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Rhabdochona paski	*Alestes macrophthalmus*	*Tanzania*	Aloo, PA. (2002)
	Spinitectus petterae	*Clarias werneri*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	Travnema sp.	*Clarias liocephalus*	Lake Victoria, Tanzania	Mwita and Nkwengulila (2008)
	CRUSTACEA (Branchiura)			
	Argulus monodi	*Heterobranchus longifilis*	Malagarasi River, Tanzania	Mwita and Nkwengulila (2008)
	Chonopeltis brevis	*Barbus altianalis radcliffi Labeo victorianus*	River Mugambuzi, Tanzania	P Akoll and WW Mwanja. (2012)
	Chonopeltis flaccifrons	*Marcusenius welwerthi*	Malagarasi swamps, Tanzania	P Akoll and WW Mwanja. (2012)
	Chonopeltis schoutedeni	*Mormyrus sp.*	Malagarasi swamps, Tanzania	*P Akoll and WW Mwanja. (2012)*
	Dolops ranarum	*Auchenoglanis occidentalis, Bagrus bayad, B. docmac, Clarias gariepinus, Lates niloticus, Oreochromis esculentus, O. variabilis*	Lake Victoria Tanzania	Mwita and Nkwengulila (2008).
	CRUSTACEA (Copepoda)			
	Afrolernaea longicollis	Mormyrus sp.	Malagarasi swamps, Tanzania	P Akoll and WW Mwanja. (2012)

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	Ergasilus kandti	*Lates niloticus, Lates spp.*	Lake Tanganyika, Tanzania	Paperna (1996)
	Lamproglena clariae	*Heterobranchus longifilis*	Malagarasi swamps, Tanzania	P Akoll and WW Mwanja. (2012)
	Lernaea haplocephala	*Polypterus congicus*	Malagarasi swamps, Tanzania	P Akoll and WW Mwanja. (2012)
	BACTERIA			
	Aeromonas hydrophila	*O. niloticus*	*Morogoro rural (7°023672'S, 37°340920'E), (6°075187'S, 37°373722'E), (6°500632'S, 37°414212'E). Mvomero (6°234376'S, 38°692045'E), Masasi (10°400358'S, 38°555169'E), (11°060000'S, 38°390000'E), Songea (10°404759'S, 35°283163'E), (10°492114'S, 35°322649'E).*	*Nikuli,H.L et al., 2012.*
	Pseudomonas aeruginosa	*O. niloticus*		*Nikuli,H.L et al., 2012.*
	Pseudomonas f luorescens	*O. niloticus*		*Nikuli,H.L et al., 2012.*
	VIRUSES			
	Lymphocystis virus	*Oreochromis amphimelas, O. esculentus*	Lake Kitangiri, Lake Victoria – Tanzania	*P Akoll and WW Mwanja. (2012)*

ANNEX 1D: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION – BURUNDI

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	CESTODES			
	Proteocephalus beauchampi	*Chrysichthys brachynema*	Burundi	P Akoll and WW Mwanja. (2012)

ANNEX 1E: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION –RWANDA

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
	CRUSTACEAN (Branchiura)			
	Argulus rhipidiophorus	*Oreochromis niloticus*	Lake Kivu, Rwanda	P Akoll and WW Mwanja. (2012)
	Lake Kivu, Rwanda	*P Akoll and WW Mwanja. (2012)*	*Lake Kivu, Rwanda*	*P Akoll and WW Mwanja. (2012)*

ANNEX 1F: LIST OF AQUATIC ANIMAL DISEASES AND THEIR DISTRIBUTION – SUDAN, SOUTH SUDAN, ETHIOPIA, SOMALIA AND DJIBOUTI

SN	NAME OF THE DISEASE	INFESTED HOST	LOCATION/COUNTRY WHERE THE PARASITE WAS FOUND	REFERENCES
No Aquatic Animal Diseases reported in the Questionnaire and literature citation noted as per this study.				

ANNEX 2: INVENTORY OF NATIONAL AND REGIONAL AQUATIC ANIMAL DISEASE STRATEGIES

Sn	Country	Aquatic Animal Health Policy		Aquatic Animal Health Reporting System		Aquatic Animal Disease Diagnostic Facility			Comments
		Present	Absent	Present	Absent	Present	Absent	Inadequate	
	SUDAN								
	KENYA								Aquatic Animal Health Reporting System is at farm level.
	BURUNDI								
	RWANDA								
	UGANDA								Not Aquatic Animal Health specific, Have limited diagnostic capacity.
	TANZANIA								Have limited diagnostic capacity. Aquatic Animal Health issues are reported at National (OIE delegate) and International (OIE).

NB: South Sudan, Ethiopia, Somalia and Djibouti did not report.

ANNEX: 3A: FACTORS ASSOCIATED WITH OCCURRENCE AND SPREADING OF AQUATIC ANIMAL DISEASES IN THE REGION

STATE	BIOLOGICAL			ENVIRONMENTAL			SOCIO-ECONOMIC	COMMENTS
	Predators	Production system	Vector/ reservoirs	Season	Geographical	Water shed/body	Trade	
SUDAN								Sudan not reported any factor associated to outbreak and spread of diseases.
UGANDA								
KENYA								
TANZANIA								
BURUNDI								Burundi not reported any factor associated to outbreak and spread of diseases.
RWANDA								

ANNEX: 3B: RISKS ASSOCIATED WITH OCCURRENCE AND SPREADING OF AQUATIC ANIMAL DISEASES IN THE REGION

Country	Aquatic Farmed Sp	Stocking Rate	Sources of Genetic Material	Issuing of Health Certificate		Genetic Material Exchange Among Farmers		Import/Export of Genetic Material		Exchange of Fishing Gears	
				Yes	No	Yes	No	Yes	No	Yes	No
RWANDA	*O. niloticus*	Pond – 3/ M^2	Hatchery	Minor extent		Greater extent	Some extent			Greater extent	
		Cage – 100-150/ M^3									
UGANDA	*Oreochromis niloticus*	Ponds –(3-10 fish/M^3), Tanks – (5-20 fish/ M^3), cages (75 – 200 fish/ M^3).	Wild and Hatchery		Not at all	Greater extent			Not at all	Greater extent	
	Clarias gariepinus	Ponds (3-5 fish/ M3) Tanks (5-20 fish/ M^3)									
	Cyprinus carpio.	Ponds (3-10 fish/ M^3).									
TANZANIA	O. niloticus	Ponds –(3-10 fish/ M3) cages (50 – 150 fish/ M3).	Wild and Hatchery		Not at all	Greater extent		Some extent		Greater extent	

Country	Aquatic Farmed Sp	Stocking Rate	Sources of Genetic Material	Issuing of Health Certificate		Genetic Material Exchange Among Farmers		Import/Export of Genetic Material		Exchange of Fishing Gears	
				Yes	No	Yes	No	Yes	No	Yes	No
	C.gariepinus	Ponds (2-3 fish/ M3)	Wild and Hatchery				Not at all				
	C. chanos	Pond 3-6 fish/M3	Wild								
KENYA	O. niloticus	3 fish/ M3	Wild and Hatchery	Greater extent		Some extent		Some extent		Some extent	
	C.gariepinus	3 fish/ M3									
	O. Mykiss	30 fish/ M3									
	Gold fish										
	Koi carps										
BURUNDI	O. niloticus	6 fish/ M^3	Wild and Hatchery		Not at all	To a greater extent		To a minor extent		No information	No information
	Clarias gariepinus	6 fish/ M^3									
SUDAN	O. niloticus		Minor extent		Not at all		Not at all		Not at all		Not at all
RISK SITUATION			Wild sources (83.3%)	33.3%	66.7%	83.3%	16.7%	66.6%	33.7%	80%	20%
			Hatchery sources (16.7%)								

ANNEX 4: OPPORTUNITIES, ISSUES AND CHALLENGES FOR AQUATIC ANIMAL DISEASE CONTROL

SN	COUNTRY	OPPORTUNITIES	ISSUES	CHALLENGES	REPORTER
	UGANDA	Availability of Diagnostic labs at Infrastructure for research Availability of Competent Authorities (CA).	Strong legislation against unauthorized and organized fish movements, sensitizing of farmers on fish movements, BMPs of fish farming and broodstock management, certification of hatcheries and broodstock producers; development of a comprehensive fish disease management plan, human and infrastructure (labs and equipment) development.	Lack of legislation, low human and infrastructure capacities, lack of sensitization of farmers of the dangers of unauthorized and organized fish movements, lack of certification of seed/broodstock producers, porous borders,	Dr. Mwanja Tenywa Matthew (Fish Geneticist/Breeder). Dr. John Walakira (Research Scientist) Ms Joyce Nyeko Ikwaput (Assistant Commissioner for Fisheries)

SN	COUNTRY	OPPORTUNITIES	ISSUES	CHALLENGES	REPORTER
			More investment in research Training/capacity building Establishing National & Regional Aquatic Health Plan/Strategy		
	TANZANIA	Availability of competent Authority Availability of laboratory infrastructures Availability of research institutions, Opportunity For Laboratory Twinning	Developing Aquatic Animal Health specific Legislations, AAH Certification for aquatic animal movement, Developing Quarantine facilities in all hatchery facilities.	Availability of Human resources, Reference laboratories. Establishing a comprehensive National & Regional Biosecurity plan;	Dr. Hamisi L. Nikuli (Aquatic Animal Health Coordinator)
	KENYA	Sagana Fish farm and Kiganjo trout hatchery can offer excellent facilities for these operations	Setting up of State of the Art laboratories for disease diagnosis' Setting up Quarantine facilities in all public and private hatchery facilities		W.M. Gichuri (Director of Aquaculture)
	SUDAN			Future plans for preventive and control of aquatic animal diseases. Increasing of fish farms leads to more risks in disease	Mr. Ammar Othman Elobied (Assistant Research Professor)
	BURUNDI	None	None	Risks from pollution	KAREGA Déogratias. (Responsible Aquaculture Development National Center of Artisanal Fisheries)

SN	COUNTRY	OPPORTUNITIES	ISSUES	CHALLENGES	REPORTER
	RWANDA	Stocking densities still low (Farming systems are not yet intensive), being a land locked country.	Development of the Policy and laws that govern this, Establishment of a competent authority, Establishment of a Laboratory, Training of technicians, Sensitization of farmers.	Lack of competent personnel, equipments, laboratories, Policies and laws	

ANNEX 5: AQUACULTURE PRODUCTION SYSTEMS AND FARMED AQUATIC ANIMAL SPECIES IN THE REGION

COUNTRY	SPECIES FARMED	AQUACULTURE PRODUCTION SYSTEMS	COMMENTS
KENYA	Nile tilapia (Oreochromis niloticus), Catfish (Clarius gariepinus), Trout, Goldfish and Koi carps	Ponds, cages, plastic tanks.	
RWANDA	Tilapia and Catfish,	Ponds, cages ans plastic tanks	
UGANDA	Tilapia, Catfish, Carps (exotic and native), Oreochromis niloticus, Clarias gariepinus & Cyprinus carpio, Tilapia (Oreochromis niloticus and Tilapia zilli) and African Catfish (Clarias gariepinus) and Mirror carp (Cyprinus carpio).	Ponds, cages, plastic tanks.	
SUDAN	Pinctada margaritifera, Oreochromis niloticus, Lates niloticus, Clarius lazira and Labio spp.	Ponds	FAO. (2008). Fisheries Country Profile – Sudan.
TANZANIA	Oreochromis niloticus, Pinctada margaritifera, Clarias gariepinus, Milk fish (chanos chanos), mud crabs (Scylla serrata), Rainbow trout (Oncorhynchus mykiss).	Ponds, Cages and Hapas.	
BURUNDI	Oreochromis niloticus and Clarias gariepinus	Ponds, Cages and plastic tanks	Aquaculture is at its infancy stage.
SOUTH SUDAN	Oreochromis niloticus and Clarias gariepinus	Ponds	FAO, (2014)
SOMALIA	Oreochromis niloticus and Clarias gariepinus	Ponds	ACP Fish II, (2013)
RWANDA	Oreochromis niloticus and Clarias gariepinus	Ponds, Cages and plastic tanks	ACP Fish II, (2013)

ANNEX 6A: CONTACTS AND DESIGNATION OF PERSONS CONTACTED IN THE STUDY FOR GATHERING INFORMATION (Chief Veterinary Officers)

BURUNDI (Responded to the Questionnaire) Dr. Deogratias Nsanganiyumwami, Directeur de la Santé Animale/Délégué de l'OIE, Ministère de l'Agriculture et de l'Elevage, BP 161, Gitega, Bujumbura, BURUNDI, Tel: +257 79 922 222/770 18596, Fax: +257 77 018 596, Email:nsanga5@yahoo.fr	**ETHIOPIA** (Did not respond to the Questionnaire) Dr. Bewket Siraw Adgeh, Chief Veterinary Officer & OIE Delegate for Ethiopia, Director, Animal and Plant Health Regulatory, Directorate, Ministry of Agriculture , Lamberet (Near ILRI), P.O Box 62347, Addis Ababa, ETHIOPIA, Tel: (251 11) 646 1277/ 9 11 825 270, Fax: (251 11) 64 62 003, Email: bsiraw@yahoo.com; aubiergefr@yahoo.fr
DJIBOUTI (Did not respond to the Questionnaire) Dr Moussa Ibrahim Cheik, Directeur de l'Elèvage et de Services Vétérinaire, Ministère de l'Agriculture, de l'Elevage et de la Pêche, Djibouti, DJIBOUTI. Tel : +253 77 831 030 Email: moussaicheik@yahoo.fr pace@intnet.dj	**KENYA** (Responded to the Questionnaire) Dr. Kisa Juma Ngeiywa, Chief Veterinary Officer, State Department of Livestock, Ministry of Agriculture, Livestock and Fisheries, Kabete Veterinary Laboratories, Private Bag 00625, Kangemi, Nairobi, KENYA. Tel: +254 722376237 Email: kisajuma@yahoo.com
RWANDA (Respond to the Questionnaire) Dr. Theogene Rutagwenda, Director General, Ministry of Agriculture and Animal Resources, P.O. Box 621, Kigali, RWANDA. Tel: +250 788 303 309 Fax : +250 252 585 057 Email: rutagwendat2006@yahoo.com	**SOMALIA** (Did not respond to the Questionnaire) Dr Farah Mohamed Ali, Director of Animal Health Department, Chief Veterinary Officer, Ministry of Livestock, Forestry and Range, World Organisation for Animal Health (OIE), C/O Patrick Bastiaensen, P.O. BOX 19687, 00202 NAIROBI , KENYA.
SOUTH SUDAN (Did not respond to the Questionnaire) Dr Jacob Korok, Acting Director General of Veterinary Services (CVO), Livestock and Fisheries Industry, Juba, SOUTH SUDAN. Tel: +211 956 479 074 E-mail: jacobkorok@yahoo.co.uk	**SUDAN** (Responded to the Questionnaire) Dr Kamal Tag Elsir Al Sheikh, Undersecretary, Chief Veterinary Officer, OIE Delegate, Federal Ministry of Livestock, Fisheries and Rangelands, P O. Box 293, Khartoum Sudan. Tel: +249 912 338 522 Fax: +249 183 475 996 Email : kemojahiz@gmail.com

TANZANIA (Responded to the Questionnaire) Dr. Abdu Amman Hayghaimo, Director of Veteirnary Services, Ministry of Livestock and Fisheries Development, PO Box 9152 , Dar Es Salaam, TANZANIA. Tel : +255 784 363631/+255 754 894 218 Fax : +255 862 592 Email: haygh.aa@gmail.com; ahayghaimo@gmail.com Dr. Hamisi L. Nikuli, Aquatic Animal Health Coordinator, Ministry of Agriculture Livestock and Fisheries, PO Box 9152, Dar Es Salaam, TANZANIA. E-mail: Nikuli.fr@gmail.com	**UGANDA** (Responded to the Questionnaire) Dr Nicholas Kauta, Director, Animal Resources, Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), PO Box 513, Entebbe, UGANDA. Tel: +256 772 693 257 Fax: +256-414 322 297 Email: nicholaskauta@yahoo.co.uk; kauta.nicholas83@gmail.com

ANNEX 6B: CONTACTS AND DESIGNATION OF PERSONS CONTACTED IN THE STUDY (Director of Fisheries)

COUNTRY	NAME OF DIRECTOR	E-MAIL	TEL.	REMARKS
BURUNDI	Ms. Nzeyimana Leonie	*nzeyile@yahoo.fr*		(Responded to the Questionnaire)
DJIBOUTI	Mr. Ahmed Darar Djibril	*djidarar@hotmail.com*	Tell : +253 845776	(Not responded to the Questionnaire)
ETHIOPIA	*Mr. Hussein Abegaz Issa*	*Husseinfish99@gmail.com*	2519 117 2571 /+251 (0) 115 510 190	(Not responded to the Questionnaire)
KENYA	Susan Imende	*susanimende@yahoo.com*		(Responded to the Questionnaire)
RWANDA	Dr Theogene Rutagwenda/ wilson RUTAGANIRA	*rutagwendat2006@yahoo.com / wilsonruta@yahoo.co.uk*	Tel:(250) 788 303 309 / +250788306364	(Responded to the Questionnaire)
SOMALIA	DR. Ahmed Mohamed Iman	*dgeneral.fishery@yahoo.com*	Tel: 2522615562766	(Not responded to the Questionnaire)
SOUTH SUDAN	Sarafino Aloma Francis	*sarafinoaloma@ymail.com*	Cell : +211 0955 187673	(Not responded to the Questionnaire)
SUDAN	Dr. Nadia Elderdiry Omer Karoun	*mohamedkarar1998@hotmail.com*	Tel: 0111253422	(responded to the Questionnaire)
TANZANIA	Mr. Hosea Gonza Mbilinyi	hoseagonza@yahoo.com	+255 719 046736/784 455530/745 030363	(responded to the Questionnaire)
UGANDA	Dr. Rukuunya Edward	edwardrukunya@yahoo.com	Mob+256 772 413 279/700 148 275	(responded to the Questionnaire)

ANNEX 6 C: PARTNERS AND REGIONAL FISHERIES BODIES –EAST AFRICAN REGION

WWF- EAST AFRICA (Not responded to the Questionnaire)

Dr. Taye Teferi,
Regional Conservation Programme Director,
WWF-ESARPO ,
PO Box 62440-00200 Nairobi-KENYA.
Tel: +254 203877355
E-mail: tteferi@wwfesarpo.org

LTA (Not responded to the Questionnaire)

Mr. Jean Marie NIBIRANTIJEExecutive Director,
Lake Tanganyika Authority Secretariat,
P.O. Box 4910 Ngagara, Kigobe North, Bujumbura – Burundi.
Country code: +257
Phone: 22 273 585
Fax: 22 275 663
E-mail: info@lta-alt.org

ANAF (Not responded to the Questionnaire)

Mr. Bright Onapito,
Aquaculture Information Expert,
Aquaculture network for Africa –ANAF,
PO Box 1625 Jinja.
Tél. : (256)792782629
E-mail: bonapito@lvfo.org
/ onabright@gmail.com

LVFO (Responded to the Questionnaire)

Mr. Godfrey Monor,
Executive Secretary ,
Lake Victoria Fisheries Organization,
Jinja / UGANDA.
Email : monorgv@lvfo.org

Mr. SAMSON ABURA,
IRFS–RFP / EAC-LVFO,
East African Community,
Box 1625,
Jinja / UGANDA.
Tel: + 256 776859297
Fax: 434123123
E-mail: sbabura@lufo.org

NGOs (Not responded to the Questionnaire)

MS Beth Wagude,
Kenya Fish Processors & Exporters Association,
East African Industrial Fishing and Fish processors Association (EAIFFPA),
Phone +254 20 4440858 ,
Fax +254 20 4440858 ,
P.O. Box 345 - 00606 ,
New Rehema Hse, Rhapta Street, Westlands Nairobi Kenya.
E-mail: beth.wagude@afipek.org

Manor Godfrey Vincent,
Executive Secretary,
Lake Victoria Fisheries Organization ,
P.O Box 1625,
Jinja, UGANDA.
Mob: +256 776 705634
monorgv@lvfo.org ; monorgv@gmail.com

Kaitira Ibrahim Katonda,
Director of Fisheries ,
Lake Tanganyika Authority,
BP 4910 – Ngagara,
Bujumbura, BURUNDI.
Tel:+257 79138000
kaitira.katonda@-alt.org

REGIONAL FISHERIES BODIES (Not responded to the Questionnaire)

John Rao Nyaoro,
Nile Basin Authority,
Executive Director,
Plot 12, Mpigi Road P.O Box 192,
Entebbe Nile Basin Initiative Secretariat.
(256)754820485
jnyaoro@nilebasin.org

NON-STATE ACTORS ORGANISATIONS (Not responded to the Questionnaire)

Mr. Silvano Namadoa,
Director,
FISHNET AFRICA.
P.O. Box 15699-00100
Nairobi-Kenya.
Tel: +254 738 322 016/723 769 916
Email: namadoa@fishnetafrica.org; namadoa.okeloh@gmail.com

Logose Perus,
Chairperson,
c/o Person Kiyindi Women F/PA,
Ministry of Agriculture Animal Industry & Fisheries,
P.O. Box 03 BUIKWE, UGANDA.
anatseba@yahoo.comm
Tel: +256 785221623

Eboko Joyce,
Program Coordinator,
Bungoma Small Scale Fisheries,
P. O. Box 50285,
Bungoma, Kenya.
+254 711777235
Eboko.Joyce@gmail.Com

HUMAN CAPACITY DEVELOPMENT (Not responded to the Questionnaire)
Edward Kimakwa,
Fisheries Programme Manager,
WWF Coastal East Africa Global Initiative,
P.O. Box 63117, Dar es Salaam, Tanzania.
Tel: +255 22 2775 346
Mobile: +255 787867732
E-mail: ekimakwa@wwfafrica.org

REGIONAL ECONOMIC COMMUNITIES

COMESA (Not responded to the Questionnaire)

Mphumuzi Sukati (Phd),
Agricultural Economist,
COMESA Secretariat,
Ben Bella Road, P.O. Box 30051, Lusaka, Zambia.
Phone: +260 211 229725/32
Mobile +260 961 958 420
E-mail: MSukati@comesa.int

IGAD (Not responded to the Questionnaire)
Eshete Dresilign Dejen,
Fisheries Expert,
IGAD SECRETARIAT
P.O BOX 2653, DJIBOUTI.
Tel: 25321354050
E-mail: Eshete.dejen@igad.int; eshetedejen@gmail.com

SADC (Not responded to the Questionnaire)
Dr Motseki Hlatshwayo,
Senior Technical Advisor,
SADC Secretariat,
Private Bag 0095,
GABORONE BOTSWANA.
E-mail:hlatshwayo2001@yahoo.com
Tel: 26771369071 or 27822918173

UMA (Not responded to the Questionnaire)
Faouzia CHAKIRI,
Ingénieur en chef agro-économiste,
Chef de Division,
Direction de la Sécurité Alimentaire,
Union Maghreb Arabe.
Tel: +212 661229461
E-mail: sg.chakiri@gmail.com Manor Godfrey Vincent

Executive Secretary,
Lake Victoria Fisheries Organization ,
P.O Box 1625,
Jinja, UGANDA.
Mob: +256 776 705634
monorgv@lvfo.org ; monorgv@gmail.com

Kaitira Ibrahim Katonda,
Director of Fisheries,
Lake Tanganyika Authority,
BP 4910 – Ngagara,
Bujumbura, BURUNDI.

Tel:+257 79138000
kaitira.katonda@-alt.org

CAOPA (Not responded to the Questionnaire)
Mr. Silvano Namadoa,
Director,
FISHNET AFRICA.
P.O. Box 15699-00100
Nairobi-Kenya.
Tel: +254 738 322 016/723 769 916
Email: namadoa@fishnetafrica.org; namadoa.okeloh@gmail.com

Logose Perus,
Chairperson,
c/o Person Kiyindi Women F/PA,
Ministry of Agriculture Animal Industry & Fisheries,
P.O. Box 03 BUIKWE, UGANDA.
anatseba@yahoo.comm
Tel: +256 785221623

Eboko Joyce,
Program Cordinator,
Bungoma Small Scale Fisheries,
P. O. Box 50285,
Bungoma, Kenya.
+254 711777235
Eboko.Joyce@gmail.Com

AFRM working Finance & Investment (Not responded to the Questionnaire)
Edward Kimakwa,
Fisheries Programme Manager,
Coastal East Africa Global Initiative,
P.O. Box 63117, Dar es Salaam, Tanzania.
Tel: +255 22 2775 346
Mobile: +255 787867732
E-mail: ekimakwa@wwfafrica.org

IOC (Not responded to the Questionnaire)
Mr. Léon Martial Harijhonse RAZAKA,
Head of Mission,
Indian Ocean Commission,
Mauritius.
harijhons.razaka@coi-ioc.org

Ms Claudia Laguette
claudia.laguette@coi-ioc.org

SWIOFC (Not responded to the Questionnaire)

Harris, Aubrey (FAOSFS),
Senior Fisheries Officer,
Aubrey.Harris@fao.org

ANNEX 7 A: CHECKLIST/QUESTIONNAIRE FOR MAPPING STUDY OF AQUATIC ANIMAL DISEASES IN EASTERN AFRICA AND IGAD COUNTRIES FOR CVOs AND DIRECTOR OF FISHERIES

The African Union Interafrican Bureau for Animal Resources (AU-IBAR) is a specialized technical office reporting to the Department of Rural Economy and Agriculture of the AU Commission. The Institution is mandated to support and coordinate the improvement of livestock, fisheries and wildlife as a resource for human well-being in the member states of the African Union and contribute to economic development, particularly in rural areas.

AU-IBAR is conducting aquatic animal disease mapping study in Eastern and IGAD countries involving 10 Partner States. The countries that comprise Eastern Africa fall within East Africa Community (Kenya, Uganda, Tanzania, Rwanda and Burundi) and IGAD (Ethiopia, Sudan, South Sudan, Djibouti and Somalia).

The study is conducted by the consultant (Dr. Hamisi L. Nikuli) on behalf of AU-IBAR. Therefore, on behalf of AU-IBAR consultant is kindly requesting you on behalf of your country to produce the following information in the form of Questionnaire.

The objectives of the proposed aquatic animal disease mapping study therefore are to:

1. Determine the current status of aquatic animal diseases within countries.
2. Establish the production systems (fisheries and/or aquaculture) where they occur.
3. Establish disease risks determinants.
4. Establish the geographical areas where these diseases have occurred.

In fisheries, AU-IBAR undertaking is through Fisheries Governance Project and Africa's Fisheries and Aquaculture Framework. The aim of the Framework and goal of Fisheries Governance is to contribute towards the "Sustainable management and utilization of fisheries and Aquaculture resources through the creation of a conducive and enabling environment for equitable, economic and social development in Africa".

I am sending this Questionnaire and kindly fill the form and return before 5th February 2016 via e-mail: nikuli.fr@gmail.com. Skype: Hamisi Nikuli (call time: From 08:30-15:30).

The information obtained from this Questionnaire will solely be used by AU-IBAR and not otherwise.

A. RESPONDENT PARTICULARS

1. Country.....
2. Name of respondent.....
3. Designation .....Contacts.....

B. PRODUCTION INFORMATION AND RISK ANALYSIS

4. Which Fish spp are kept in the country .....……
5. Type of Production system Country wise by species (e.g pond, cage, plastic tank)..... average stocking density by species per (M3)……

6. Generally over the last 10 years, has production been Increasing ☐ Decreasing ☐ Stable ☐ Stopped ☐ Fluctuating ☐

7. To what extent are the aquatic organisms farmed in this area sourced as wild seed or from wild brood stock? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

8. To what extend Health certificates are issued prior transfer of Aquatic genetic material? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

9. To what extend are the Aquatic genetic materials are exchanged between fish farmers? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

10. To what extend are the Aquatic genetic materials are imported/exported? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

11. To what extend are fishing gears are exchanged among fish farmers during fish harvesting? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

12. Mention opportunities that exist for Aquatic Animal Disease Control in the country?

13. Mention do you think are Challenges that exist in Aquatic Animal Disease Control in the country?

14. Mention issues need to be addressed in order to undertake disease control in the country?

15. Do the country has National Aquatic Animal Disease Control Policies and Measures? Yes ☐ No ☐

If Yes, Is it specific National Aquatic Animal Disease Control Policies and Measures? OR Part of the main Policies and Measure? ☐

If No, what are the future plans? ☐

16. To what extend National Aquatic Animal Disease Control Policies and Legislation are implemented? Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

17. How strong Biosecurity in Hatcheries, farms and other Aquaculture facilities? Not at all To some extend ☐ To a minor extend ☐ To a greater extend ☐

18. Do the country has capacity to undertake diagnosis of Aquatic animal diseases Yes ☐ No ☐

19. Is the area has Aquatic animal health professional(s)? Yes ☐ No ☐ Not known

C. AQUATIC ANIMAL DISEASE INFORMATION

Situation Analysis/Overview of Prevalence and Incidences of aquatic animal diseases in the country

20. Is there any history of reported Aquatic animal disease(s) outbreak over the past ten years? Yes ☐ No ☐ Not known ☐

21. If Yes which are the major aquatic animal diseases in the country? (IN EACH DISEASE)

If more than one disease, just list the disease, species affected and name of the place of outbreak (Famous place)

ii) Disease name: ……..

iii) Which aquatic animal species affected? ……include ornamental

fish? Which age? Young ☐ Adults ☐

iv) Is there fish mortality Yes ☐ No ☐ Not known ☐ If Yes, what the estimated percent.....

v) Is the disease Endemic ☐ Notifiable ☐ Transboundary ☐ Emerging ☐

If Notifiable, To which level (National, International e.g OIE) ……..

vi) Type of production system where the disease outbreak occurred……

vii) Environmental factors: Water quality where the disease occurred Average pH…. Average Biological Dissolved Oxygen (BDO)…… Average salinity…. Average Ammonia level……. and Average water Temperature…….

viii) What is the species stocking density in the facility where the disease has occurred per M3……..

ix) Location: names of places: (famous name-can be found in the GPS) …….. name of the water body …….. (Village)…….. Ward……

District…….. Region……..

x) Which aquatic ecosystem the disease occurred: Wild (rivers, lakes) ☐ Farm / Hatchery ☐

xi) Species sanitary

If is the farm/Hatchery. What is the culture system in the facility Monoculture ☐ Polyculture ☐ If it is polyculture, which type of species (Mention)……

If is the farm/Hatchery. What is the common source of water into facilities where the disease occurred? Mention…….

xii) What is the Prevalence (%) of the disease in the country?

xiii) Do you think what are the Factors associated with the occurrence and spread of diseases in the country:

- Biological Factors

Predators ☐
Production system ☐
Vector/Reservoirs (Other aquatic animal species) ☐
Others mention…….

- Environmental Factors

Season ☐
Geographical attributes ☐
Watershed/water body, etc) ☐
Others mention…….

- Socio-Economic Factors

Trade, commodity (live fish, processed, etc)
Others mention…….

- Others factors (mention)…….

xiv) Which months mostly disease outbreaks? Warm season ☐ Cold season ☐ Not known

xv) Mention the implications of its occurrence on production, fish consumption and trade

xvi) What is the estimated overall loss in USD cause by the disease in the farm/wild…….

xvii) Any intervention undertaken to calm the situation? Yes☐ No☐ Not known ☐

If Yes. Briefly mention……..

22. Is Aquatic Animal Health Reporting System Present? (yes/no). If yes, at which level: farm-level national ☐ International ☐

23. Is Aquatic Animal Disease Diagnostic Facilities Present in the Country? (yes/no/ not adequate)

24. What are the percentages of Farming system in the country:

(i) Intensive ☐
(ii) Semi intensive ☐
(iii) Extensive ☐
(iv) Integrated ☐

25. What are the Challenges associated with the Control of Aquatic Animal Diseases in the country

26. What are the recommendations regarding status and Control of Aquatic Animal Diseases in the country

……END……

Thank you so much for your contribution and great comments for fulfilling the requirements of this questionnaire. If there is any further clarification, please let us know and we will contact you via your e-mail, skype and phone. {Our contacts (AU-IBAR and Consultants) see on our e-mails address}.

Consultant's contacts:
E-mail: nikuli.fr@gmail.com
Mobile tel: +255 782 543 054 / 759 404 284
Skype: Hamisi Nikuli (call time: From 08:30-15:30).

ANNEX 7B: CHECKLIST/QUESTIONNAIRE FOR MAPPING STUDY OF AQUATIC ANIMAL DISEASES IN EASTERN AFRICA AND IGAD COUNTRIES FOR RFBs, RECs AND NGOs

The African Union Interafrican Bureau for Animal Resources (AU-IBAR) is a specialized technical office reporting to the Department of Rural Economy and Agriculture of the AU Commission. The Organization is mandated to support and coordinate the improvement of livestock, fisheries and wildlife as a resource for human well-being in the member states of the African Union and contribute to economic development, particularly in rural areas.

AU-IBAR is conducting aquatic animal disease mapping study in Eastern and IGAD countries involving 10 Partner States. The countries that comprise Eastern Africa fall within East Africa Community (Kenya, Uganda, Tanzania, Rwanda and Burundi) and IGAD (Ethiopia, Sudan, South Sudan, Djibouti and Somalia).

The study is conducted by the consultant (Dr. Hamisi L. Nikuli) on behalf of AU-IBAR. Therefore, on behalf of AU-IBAR consultant is kindly requesting you on behalf of your country to produce the following information in the form of Questionnaire.

The objectives of the proposed aquatic animal disease mapping study therefore are to:

1. Determine the current status of aquatic animal diseases within countries.
2. Establish the production systems (fisheries and/or aquaculture) where they occur.
3. Establish disease risks determinants.
4. Establish the geographical areas where these diseases have occurred.

In fisheries, AU-IBAR undertaking is through Fisheries Governance Project and Africa's Fisheries and Aquaculture Framework. The aim of the Framework and goal of Fisheries Governance is to contribute towards the "Sustainable management and utilization of fisheries and Aquaculture resources through the creation of a conducive and enabling environment for equitable, economic and social development in Africa".

I am sending this Questionnaire and kindly fill the form and return before 10th February 2016 via e-mail: nikuli.fr@gmail.com. Skype: Hamisi Nikuli (call time: From 08:30-15:30).

The information obtained from this Questionnaire will solely be used by AU-IBAR and not otherwise.

A. RESPONDENT PARTICULARS

1. Name of Organization.....
2. Name of respondent.....
3. Designation .....Contacts.....

B. PRODUCTION INFORMATION AND RISK ANALYSIS

4. Generally over the last 10 years in the Member States, has Fisheries production been (Tick one) Increasing ☐ Decreasing ☐ Stable ☐ Stopped ☐ Fluctuating ☐

5. Does your organization consider aquatic animal diseases are issues to be addressed by your Member States? (Tick one) Not at all ☐ To some extend ☐ To a minor extend ☐ To a greater extend ☐

6. What are the issues need to be addressed by the Organization in order to undertake effective Aquatic Animal disease control to your Member States?

vi) ……
vii) ……
viii) ……
ix) ……
x) ……
xi) ……

7. Which are the challenges facing the Organization in imposing Aquatic Animal Disease Control strategies to the Member States?

i) ……
ii) ……
iii) ……
iv) ……

8. What opportunities exist for Aquatic Animal Disease Control in the Member States through your organization?

v) ……
vi) ……
vii) ……
viii) ……

9. Do the Organization has Aquatic Animal Disease Control Policies, Legislation and strategic Measures for the Member States? (Tick one) Yes ☐ No ☐

If Yes, Is it specific Aquatic Animal Disease Control Policies, Legislation and Measures? OR Part of the main Policies and Measure?

If specific, Please Name the type of Policies, Legislation and Measures.

… . , ……

10. If Yes, to what extend Aquatic Animal Disease Control Policies and Legislation are implemented in the Member States? (Tick one) Not at all ☐ To some extend ☐ To a minor extend To a greater extend

If No, is the Organization has future plans/strategies to establish and develop Aquatic Animal Disease Control Policies, Legislation and strategic measures for the Member States? (Tick one) Yes ☐ No ☐

If Yes, Briefly explain when?

11. Does the Organization have capacity to facilitate its Member States to undertake Aquatic Animal Disease surveillance, diagnosis and diseases Risk analysis? (Tick one) Yes ☐ No ☐

Which type of facilitation?

i) ……
ii) ……

iii) ……

C. AQUATIC ANIMAL DISEASE INFORMATION

Situation Analysis/Overview of Prevalence and Incidences of aquatic animal diseases in the country

12. Is Aquatic Animal Diseases Reported to the Organization by Member States? (Tick one) (yes/no)

13. What are the implications of the outbreak on production, fish consumption and trade

iii) ……
iv) ……
v) ……
vi) ……

14. Regarding contingency plan, Do the organization has contingency plan to overcome in case of Aquatic Animal Disease outbreak in the member States? Yes ☐ No ☐

What efforts the Organization put in place when there is disease outbreak in the Member States?

15. What are the Challenges associated with the Control of Aquatic Animal Diseases in the Member States.

16. What are the roles of your organization in the Control of Aquatic Animal Diseases for the Member States?

17. What are the recommendations regarding status and Control of Aquatic Animal Diseases in the Member States.

i) ……
ii) ……
iii) ……

……..END……

Thank you so much for your contribution and great comments for fulfilling the requirements of this questionnaire. If there is any further clarification, please let us know and we will contact you via your e-mail, skype and phone. {Our contacts (AU-IBAR and Consultants) see on our e-mails address}.

Consultant's contacts:
E-mail: nikuli.fr@gmail.com, Mobile tel: +255 782 543 054 / 759 404 284, Skype: Hamisi Nikuli (call time: From 08:30-15:30).



African Union – Interafrican Bureau for Animal Resources
(AU-IBAR)
Kenindia Business Park
Museum Hill, Westlands Road
PO Box 30786
00100 Nairobi
Kenya
Tel: +254 (20) 3674 000
Fax: +254 (20) 3674 341 / 3674 342
Email: ibar.office@au-ibar.org
Website: www.au-ibar.org