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WORKING PAPER: 5

FRAMEWORK FOR FISH DISEASE CONTROL IN AFRICA AQUATIC FISH PRODUCTION SYSTEMS

Executive Summary

Africa is enriched with a diverse aquatic animal resource that contributes significantly to economies of the continent. However, this resource is threatened by the existence of infectious pathogens that potentially deter development of fisheries and aquaculture sector. The emergence and outbreaks of the TAADS Aphanomyces invadans (EUS), White Spot Syndrome Virus and Abalone herpes virus in Africa brought to light the Continents' level of incapability for controlling of aquatic animal disease outbreaks. The status of aquatic animal health and the control of fish diseases is among the most important determinants for productivity, viability, environmental biosecurity, food safety and quality from the fishery and commercial aquaculture production systems. Consequently, one of the cardinal activities identified for sustainable aquaculture development and the transformation of the fisheries is enhancing capacities for Fisheries diseases surveillance and control, timely collection, analysis and sharing of accurate sanitary information by strengthening the capacity of National veterinary services for early detection, timely reporting, prevention and control of fish diseases. The Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (AUC-NEPAD, 2014) sought to increase the sectors contribution to food and nutrition security, livelihoods and economic growth in Africa. In support of this, AU-IBAR had employed mechanisms as part of the efforts to protect the aquatic environment from problems associated with aquatic diseases for increased production. Through the Fisheries Governance project, mapping of the aquatic animal diseases was initially done to determine the current status of aquatic animal diseases within countries to assist in coming up with strategies for controlling them. Other activities included establishment of continental database and network of aquatic animal health personnel and facilities, development of aquatic animal health biosecurity frameworks and plans, training animal health practitioners and managers in aquatic animal health management and biosecurity control and assessing aquatic animal disease diagnostic and surveillance capacity of member states. These activities led to a

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better understanding of the prevalence of aquatic diseases in Africa and their impact to the aquaculture industry as well as to the livelihoods. The present working paper will inform countries the mechanisms to protect the industry and environment against threats from aquatic diseases and pests. Strategies that relate to institutional arrangements, policy and legislation, laboratory networks and community participation have been recommended for use by the countries in the continent. The implementation of the stated approaches and strategies will support the effort to eliminate disease occurrence and contribute to the increase in aquaculture production in Africa.

Introduction and Background

Status of aquatic animal disease in Africa

Disease is one of the major impediments to the economic production of aquaculture. Disease outbreaks affect productivity of natural and artificial aquatic systems thus impacting negatively on livelihoods of communities who are dependent on this resource. Africa has a history of globally reportable diseases namely, Epizootic Ulcerative Syndrome (EUS), Koi Herpes Virus diseases (KHV) and White Spot Syndrome Virus (WSSV) that affects wild and cultured aquatic animals. Specifically EUS and KHV affect finfish while White spot disease affects crustaceans.

The Inter African Bureau for Animal Resources (AU-IBAR) is a specialized technical office of the African Union Commission and has the mandate to support and coordinate the utilization and management of Africa's animal resources in order to enhance the nutrition, food security and socio-economic wellbeing of the people in the Member States of the African Union'. In one of its thematic areas, AU-IBAR targets animal health, disease prevention and control systems in Africa. Within its approach to achieve the above, through the Fisheries Governance Project it undertook the following activities to contribute to one of the components on promoting sustainable commercial aquaculture development which is under one of the objectives of the project. The activities undertaken were as follows:

- Mapping of the aquatic animal diseases in Africa
- Training animal health practitioners and managers to improve their knowledge and skills in aquatic animal health management and biosecurity control
- Developing continental, regional and national aquatic animal health biosecurity frameworks and plans
- Assessing the aquatic animal disease diagnostic and surveillance capacity of member states

Through the above activities, the status of the region on aquatic animal disease was made known and a summary of the status of aquatic animal diseases in Africa are discussed below.

Distribution of reported aquatic animal diseases in Africa

Tilapia is the number one commodity aquaculture species in the world. Worldwide, Tilapia farms experience disease and to date four major bacterial diseases *Streptococcus agalactiae*, *S. iniae*, *Flavobacterium columnare* and *Francisella spp*., one viral disease iridovirus and two major groups of parasites i.e. monogeneans such as *Gyrodactylus spp*. and external protozoa such as *Trichodina spp*. and *Chilodonella spp*. are considered to be the most important pathogens. These diseases with the exception of the iridovirus are also prevalent in Tilapia culture in North Africa (AU-IBAR, 2016.). They also cause disease in mullet and carp, two species, which are commonly co-cultivated with Tilapia in this region. Koi Herpes Virus (KHV) is considered the most serious threat to carp farming in Europe and Asia with up to 100% mortality on affected farms and is currently exotic to North Africa. The majority of the remaining diseases are opportunistic pathogens. The most serious disease affecting farmed sea bass in the Mediterranean is viral nervous necrosis (VNN). It is highly pathogenic not least because it chiefly affects fry, the vulnerable early stage of the life cycle. In sea bream culture the most threatening diseases internationally are Pasteurellosis and the monogenean Sparicotyle chrysophrii. Algeria, Egypt, Libya, Mauritania and Tunisia are the countries in North Africa which have high reported cases of diseases.

Table 1: *Distribution of emerging notifiable aquatic diseases in Southern Africa*

Country	Diseases	Prevailing Water Quality parameters	Locations
Botswana	EUS	pH (4.53-6.5); Low Total Alkalinity (45 mg/L); Temperature (18-25° C)	Chobe-Zambezi River system
Namibia	EUS		Chobe-Zambezi River system
Zambia	EUS		Chobe-Zambezi River system
Madagascar	WSSV		South-West Coast
Mozambique	WSSV		Zambezia Province
South Africa	KHV		Koi farms (Limpopo and Kwazulu Natal)

Southern Africa is also affected by aquatic animal diseases and the three notifiable diseases (EUS, KHV and WSSV) are shown in Table 1 below.

Spatial distribution of these emerging diseases has serious implication to this region. There is continuous movement of live aquatic commodities within and cross-borders particularly in areas where outbreaks such as EUS occurred. Countries like South Africa have protected their aquatic biodiversity because of well-established Laws that are actually enforced. However, current economic developments (e.g. aquaculture development) in the region will probably impact on the environment. For example, the increasing demand and subsequent importation/exportation of improved fish seed (like ornamentals) in this region may enhance the spread of notifiable pathogens. EUS, KHV and WSSV have a potential to spread across the region if biosecurity measures are not well implemented; this definitely will impends initiatives to develop aquaculture, improve food security and livelihoods.

On the other hand, East Africa also registered reports of aquatic animal diseases. Ten categories of organisms are regarded to be pathogenic to aquatic animals in the region namely Protozoa, Bacteria, Viruses, Monogenea, Digenea, Cestodes, Nematodes, acathoncephala, Crustacean and Fungus. They are prevalent in Tanzania, Uganda, Kenya, Burundi and Rwanda. According to the recent 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 (Figure 1).

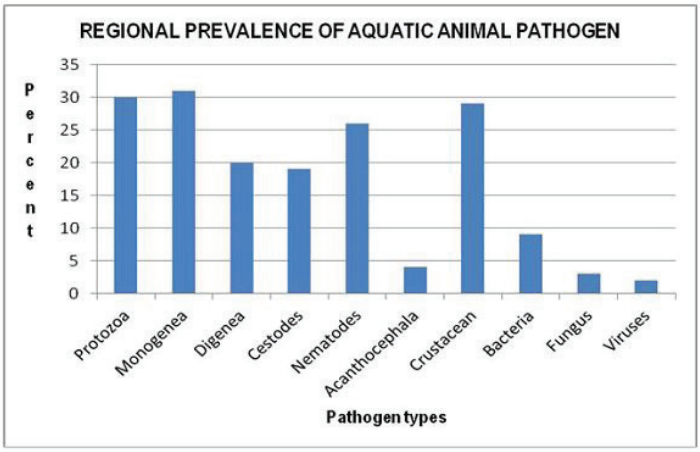

Figure 1: *Prevalence of Aquatic Animal Pathogen in East Africa*

The information obtained from earlier 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 (Figure 2).

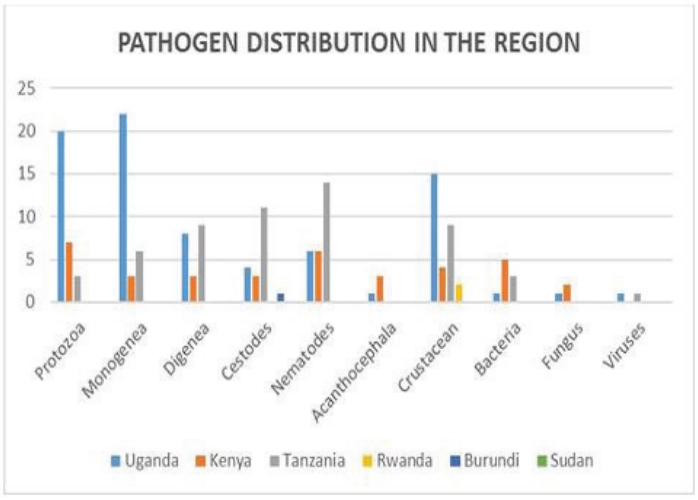

Figure 2: *Pathogen Distribution in the Eastern Africa*

Factors associated with occurrence and spread of aquatic animal diseases

Biological Factors

There are several biological factors directly associated with the fish and they include age and stress levels,

which compromise the immune system, inadequate nutrition and high stocking densities. Tropical and ornamental fish for example are susceptible to EUS infections. The etiology of Epizootic US (EUS) is a fungal pathogen Aphanomyces invadens thought to be introduced in the region through aquaculture or spot fishing using infected baits in the late 2000s. Feral finfish Barbus thamalakanensis, B. poechii and farmed Tilapia rendali in freshwater systems are also reported to be vulnerable to EUS outbreaks. Main risk factors include floods, environmental factors (salinity≤ 2 g/L; Temperature ≥ 30°C), immune system of target fish and anthropogenic factors leading to outbreaks of EUS. The etiology of White Spot Syndrome Virus affects farmed shrimp (Penaids) in marine ecosystems. Another disease called Koi herpesvirus (KHV) affect all ages of common carp (Cyrpinus carpio) but fingerlings are more susceptible to the disease.

Environmental factor

Water quality is the most important environmental factor that affect disease occurrence. Parameters such as water temperature, high organic matter, high ammonia, reduced levels of dissolved oxygen and high bacterial load can cause stress in fish and make them prone to diseases. Salinity influences specific type of pathogens especially parasites, that fish are exposed to. The different culture systems also favour the availability of certain pathogens. Earthen ponds, which are very common in Tilapia culture in North Africa, have a complex environment and the vegetation is an ideal for the survival of the infective stages of many protozoan and crustacean parasites. Water based (e.g. cages) and land-based systems (e.g. ponds and tanks) are mainly affected in wet season when non-pathogenic agents cause mass mortalities.

Socio-Economic Factors

Anthropogenic factors like pollution and destruction of the environment can enable the spread of aquatic diseases and affect livelihoods of local communities. Importation of exotic aquatic animals will subsequently introduce exotic diseases, thereby threatening aquatic biodiversity, fisheries and aquaculture investments, regional and international trade and employment opportunities for local economies. Evidently, according to FAO (2009), the spread of EUS in Zambezi river system affected millions of people in 7 countries of Angola, Botswana, Malawi, Mozambique, Namibia, Zambia and Zimbabwe.

Challenges and Opportunities

Although not in all countries, Africa still has several opportunities for the control of aquatic animal diseases as outlined by countries and these include:

- Availability of Diagnostic laboratories in other countries
- Availability of infrastructure for research
- Availability of Competent Authorities (CA)
- Opportunity for Laboratory Twinning
- Possibility of putting together a database which can be regionally updated and shared

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

- Risks from pollution
- Risk of spread and introduction of new aquatic pathogens through trade
- Future plans for preventive and control of aquatic animal diseases
- Increasing of fish farms leads to more risks in disease
- Establishing a comprehensive National and Regional Biosecurity plan
- Limited availability of human resources
- Limited availability of reference laboratories
- Inadequate capacity (knowledge and personnel)
- Inadequate information and effective harmonization of aquatic animal health issues
- Porosity of borders for fisheries and aquaculture products inspection
- Lack of legislation
- Low human and infrastructure capacities
- Lack of sensitization of farmers of the dangers of unauthorized and disorganized fish movements
- Lack of certification of seed and brood stock producers

Problem in Relation to Aquatic Diseases

Distribution of diseases has serious implication on aquaculture in the African region. Furthermore, natural fish stocks are at risk of contracting diseases if water-based aquaculture is not properly monitored. The spread of Trans-Boundary Aquatic Animal Diseases (TAADS) and emerging diseases is a big challenge among African region. 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 or 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 are through gametes (Huchzermeyer, 2014).

The region has a history of aquatic animal disease occurrence. However, over the last twenty years the frequency of reported outbreaks of emerging trans boundary Aquatic Animal Diseases (TAADS) resulting to major losses to farm and fishery production, livelihoods and food security has increased. The situation raised the concern of Africa's Heads of State and Government (AHSG), particularly because despite Africa's tremendous aquatic resource potential, the sector was evidently not gaining ground towards meeting the Comprehensive Africa Agricultural Development Program (CAADP) goals. If the fisheries and aquaculture was to contribute to the envisaged 6% agricultural GDP growth with demonstrated impact on food and nutrition security, livelihoods and wealth creation, then the sector had to transform. This led to the subsequent development and consequent endorsement of the 'Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa' (PFRS) in 2014. The PFRS is Africa's blue-print for accomplishing the sectoral transformation needed in the fisheries and aquaculture towards the CAADP. This working paper will inform countries the mechanisms to protect the industry and environment against threats from aquatic diseases and pests. The recommended strategies will guide countries in the control of spread of aquatic animal diseases in Africa.

Guidelines for Fish Disease Control in Africa Aquatic Fish Production Systems

Several guidelines have been listed below to help in the control of spread of aquatic diseases in Africa.

Policy and Legislation

Comprehensive national and regional aquatic animal health biosecurity and management strategies and plans that adopt the various World Organisation for Animal health (OIE), Food and Agriculture Organisation (FAO) and International Credential Evaluation Service (ICES) codes of practice, strengthen capacity and effectively engage stakeholders in the detection, prevention and control of aquatic animal diseases need to be developed. The strategic measures, policy and legislation need to address contingency planning, risk analysis, regional outbreak and emergency response and capacity building of stakeholders to implement Best Practices and certification and quarantine for bio-secure stock movement. The porosity of borders for aquatic animals and products should also be mitigated against in biosecurity strategies. These legislation will guide control of trans-boundary spread of aquatic animal diseases.

Institutional Arrangements

Institutional arrangements should be established that link all the relevant stakeholders and institutions involved in and/or affected by aquatic animal health. The respective institutions should be identified, accredited and have their capacity built regionally. In addition to that, there is need to set up a regional expert advisory group on aquatic animal health (REAG). This advisory group can be incorporated into an African network of aquaculture centres. The mission of the African network should be to expand the aquaculture sector by sharing responsibility for research and training and information exchange. It should also be responsible for gathering and dissemination of information, planning research and training as well as provision of advice on fish and shellfish diseases.

Laboratory networks

Well-functioning diagnostic and disease surveillance and information management systems are critical to providing evidence-based information for implementing and monitoring aquatic animal diseases. This requires well equipped laboratory networks in the region. A three-tier approach building and linking diagnostic capacity from the production environment to national and reference laboratories for confirmatory diagnosis is recommended whereby the latter are accredited laboratories with the capability for confirming notifiable conditions. This would provide increased efficiency and a large workforce of trained personnel during the process of developing systems for aquatic animal disease control. In addition, tertiary-level educational institutions would require support to ensure continued recruitment of suitably trained personnel.

New laboratories should also be nominated as a regional reference laboratory for designated aquatic animal diseases in Africa. In addition to ensuring that reference laboratory has the relevant expertise and laboratory bench skills, equipment, test reagents, efforts should also be made to incorporate capacity for microbial biosafety and containment facilities. The reference laboratory should also develop a collaboration with a high powered molecular biology group in a foreign laboratory to cover for the possibility of ever having to use whole genome scanning to identify an emerging pathogen

Community Participation

A community based approach similar to that promoted in Djibouti for terrestrial animals would benefit aquatic animal disease control in Africa. The aim of the 'Djibouti' approach is to facilitate the supervision and control of animal diseases in the field and the region. The approach advocates for strengthening the recognition of animal diseases at community level through improving networks among farming communities, animal health service providers and other stakeholders. The investment in setting up biosecurity control strategies with these key facets stands to benefit Africa's national and regional economies greatly over time.

Capacity building

Member States (MS) should have adequate capacity to enforce existing laws for controlling aquatic diseases especially TAADS. A regional diagnostic facility is also lacking but most MS have Competent Authorities (CA) who are Veterinary and Fisheries Officers. There is also need to enhance surveillance and diagnostic capacity and increase education and awareness for disease control.

Investing in research

The production of KHV-free seed that have shown to reduce this disease in South Africa (Huchzermeyer and Colly, 2015). Therefore, investing in sustainable aquatic health research can be useful in this region. A robust investigation program safeguards production and productivity, supports import risk analysis, justifies import health certification requirements, enables export health certification and provides evidence to substantiate claims of absence of a particular disease. Such procedures would ensure that decisions on aquatic animal health are evidence and scientifically based.

Instituting a system for collection and reviewing quarterly disease reports

Farmers should be obliged to keep a register of disease outbreaks and treatment regimens. A system of voluntary reporting of disease outbreaks and/or incidences of high mortalities by farmers should be put in place for review to ensure development of strategies for disease control.

The following measures should also be put in place to guide control of spread of diseases in Africa:

- Farm registration with location geo-referenced
- Routine testing of farm production stock
- Official authorization is required for movement of disinfected eggs and live fish
- Farmers should keep a register of disease outbreaks and treatment regimes
- Routine examination of slaughtered fish should be carried out

As can be noted from above, the guidelines are comprehensive and it can be expected that their

successful implementation will support the control of diseases among Africa aquatic fish production systems.

Conclusion

The need to put up strategies to prevent outbreak of trans-boundary diseases is pressing although African region is having low cases of incidences of aquatic animal diseases. The consultations that were facilitated by AU-IBAR have enabled preparation of diagnostic procedures, reporting procedures of outbreaks, suggested legislation and policies reported in this working paper. Prevention of disease outbreak will ensure increased production from aquaculture hence leading to improved livelihoods of the aquaculture dependent individuals.

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