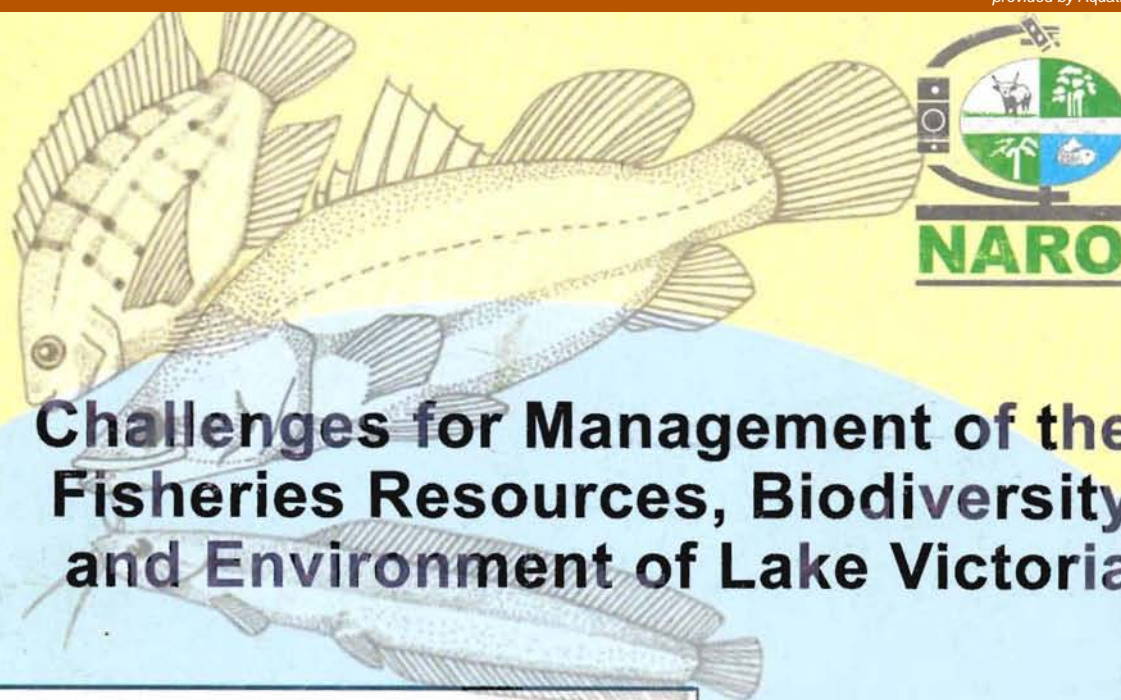
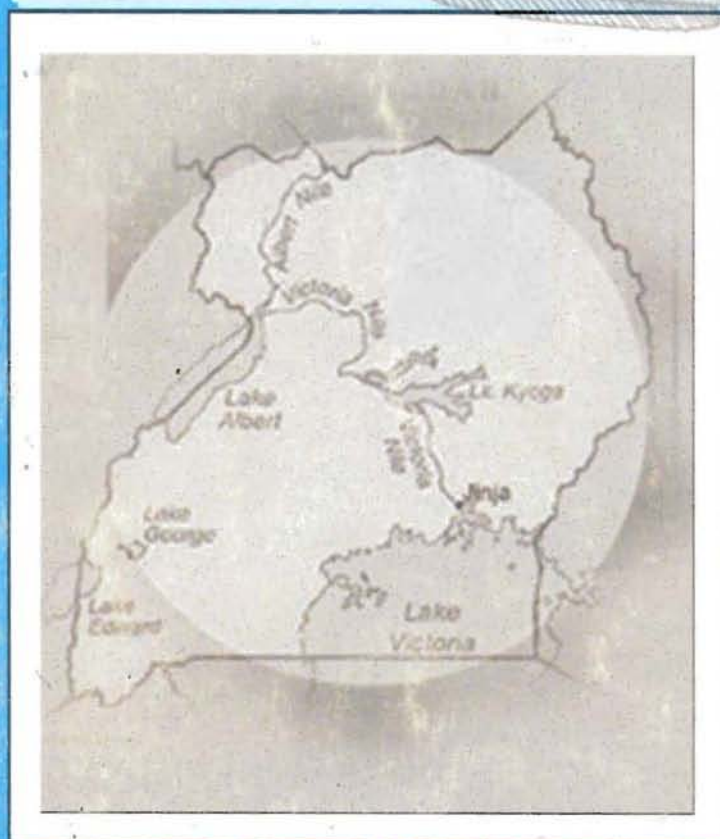


**FIRRI**



# Challenges for Management of the Fisheries Resources, Biodiversity and Environment of Lake Victoria



Editors:  
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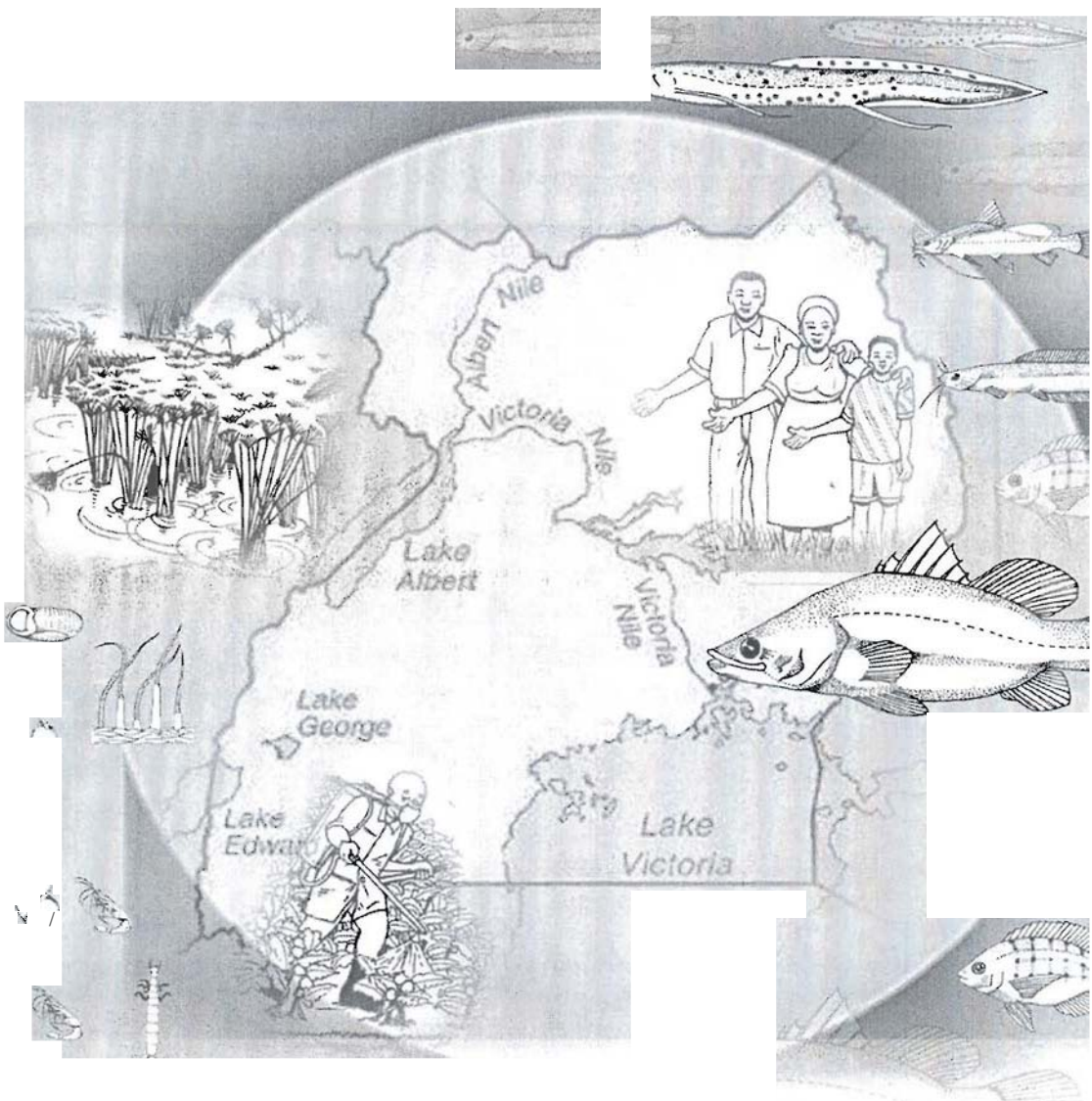
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# CHAPTER 1

## ONE

### Fisheries Research in Uganda



# Fisheries Research in Uganda

J.S. Balirwa & Ogutu-Ohwayo, R

## Introduction

Uganda is rich in aquatic resources with 18% of its surface area covered by lakes and rivers. Uganda has a current potential fish production estimated at 250,000-350,000 metric tones annually.

The most important fish production systems are in order of importance: Lake Victoria, which produces about half of the national fishery yield, followed by Kyoga, Albert, Edward and George. The more than 160 smaller lakes, rivers and streams and associated wetlands are also important fish sources especially for local communities around them. Uganda has a vast aquaculture potential, commercialization of fish farming would contribute to increased fish production.

Fisheries are very important to the national economy of Uganda and contribute to poverty eradication and livelihood of its people. The fisheries provide food, employment, income and export earnings. Fish has historically been the most affordable source of animal protein for consumption by the local people. It is an important source of revenue and foreign exchange to the extent that by 1996 it had attained second position in Uganda's export earnings. Fish flesh is rich in proteins and fish proteins are superior to those of beef and poultry in health terms. Fish flesh contains an anticholesterol which lowers the cholesterol level in human blood and assists in reducing heart disease. Some fish such as "Nkejje" are used to treat measles. The fishing industry employs up to one million Ugandans.

## Evolution of fisheries research and FIRRI

The earliest approach to fisheries research in Uganda dates from the first fisheries survey of Lake Victoria by Michael Graham between 1927 and 1928 (Graham, 1929). Based on references to the rich fisheries that were reported to Graham, it appears that during the 18<sup>th</sup> Century, catch per net per night averaged 300 tilapia, a revelation that led Graham to conclude that Lake Victoria is a tilapia lake. The "tilapia" later came to be known as *Tilapia esculenta* and *T. variabilis* (*Oreochromis esculentus* and *O. variabilis*) respectively.

Following introduction of the gill-net, records were to show a rapid decline in the catch per net (standard net of 5" mesh and 45 m long) per night from 30 prior to 1921 to about 6 in 1928, and 1.6 fish by 1954 accompanied by 100% increase in the fishing effort.

Graham's 1929 report made the following key recommendations that led to the establishment of fisheries research and fisheries management in Uganda.

1. To institute the collection of special catch statistics for use as a measure of the annual yield of the fishery,
2. To obtain complete control of the fishing power (effort),
3. To eliminate nets capable of catching small tilapia and restrict the fishery to the 5" net alone.

These recommendations were followed by surveys of the fisheries of Lakes Albert and Kyoga by Worthington who had been a member of Graham's team on the Lake Victoria survey. In addition, the Lake Victoria Fisheries Service (LVFS) and the East African Fisheries Research Organisation (EAFRO) were established between 1946-1947.

Improved understanding of the importance of fish as food, a source of money, and fishing as a form of culture led to a steady growth of EAFRO during the 1950s in terms of numbers of scientists assigned to study Tilapia. These were led by Ms Rosemary Harriet McConnell. From the 1950s, limnological factors started to feature as part of the equation in lake productivity mechanisms, and starting from the work of R.S.A. Beauchamp, Fish and Tailing, it became clear that nutrients, rainfall and temperature regimes were part of aquatic productivity mechanisms. Although studies of papyrus swamps (now recognised as lakeshore wetlands) had been studied for their role in the fisheries during the 1950s, these studies were not followed up until much later as indicated in this monograph.

The 1960s to 1970s saw an increase in staff numbers as fishes other than the fast declining Tilapias became the focus of research on Lake Victoria. The new fishes included the large-bodied commercially important *Labeo victorianus* (Ningu), *Barbus altianalis* (Kisinja), *Bagrus docmak* (Semutundu), the mormyrids (Elephant snout fishes), *C/arias garipepinus* (male) and *Protopterus aethiopicus* (lungfish). From diverse lakes, sample collections and studies of the ichthyofauna of Uganda led to the publication of a Handbook "*The Fishes of Uganda*" by Mr. P.H. Greenwood in 1966 (Greenwood, 1966) that also included references to earlier exploratory studies on many aquatic ecosystems in Uganda.

Data from the LVFS continued to be analysed by EAFRO and more species specific aspects including phytoplankton, zooplankton, macro-invertebrates and crocodiles became part of the research system. As these were fed into the newly created Fisheries Department under the Ministry of Game and Wildlife, the Fish and

Crocodile Act was enforced, but already, divergences with respect to mesh size limits were encountered in the three riparian countries (Kenya, Tanganyika, Uganda) during the late 1950s to 1960s.

From exploratory studies in the inshore zones of Lake Victoria's Napoleon Gulf and satellite lakes, it became evident that haplochromine fishes were much more diverse than previously thought by Graham. The work of Greenwood and of Fryer stimulated interest in evolutionary aspects of cichlid species flocks increased attention to Haplochromis using the British Museum (Natural History) as the base for the investigations at about the same time (late 1950s-1970s) that species introductions (Tilapias and Nile perch) were being considered as the solution to the shortage of fish supplies from Lake Victoria. These aspects are dealt with in more detail in separate chapters of this monograph.

Towards the end of the 1960s and early 1970s, the foreign scientists were departing but already, the first local scientists led by John Okedi were getting into the mainstream research on Lake Victoria and other lakes in East Africa. The EAFFRO substations were established in Kenya and Tanzania, and Haplochromis Ecology Survey Team (HEST) started its activities in Mwanza Gulf to the south of the Lake. The introduced species of fish also started to manifest in catches from lakes Kyoga and Victoria, but catch records at fish landings were to be discontinued as disruptive events through the late 1970s to 1980s took hold of fisheries research in the region. Research on other Uganda Lakes suffered during this period.

### **The Fisheries Resources Research Institute (FIRRI)**

The Fisheries Resources Research Institute (FIRRI) is the Uganda institution in charge of research in capture fisheries, the fish habitat and aquaculture. Its mandate is to undertake, promote and streamline fisheries research in Uganda and ensure dissemination and application of research results. It is one of the research institutes under the National Agricultural Research Organisation (NARO). The mandate areas of the Fisheries Resources Research Institute (FIRRI) include: capture fisheries, fishing technology, fish production processes, aquatic environmental health, aquaculture, and post harvest fisheries.

FIRRI was formed during restructuring and reorganisation of agricultural research in Uganda under the National Agricultural Research Organisation (NARO) from two previously separate national institutions namely the Uganda Freshwater Fisheries Research Organisation (UFFRO) and the Kajjansi Aquaculture Experimental Station. UFFRO had evolved from the East African Freshwater

Fisheries Research Organisation (EAFRO), which was established at Jinja by the British administration in 1948 to take care of freshwater fisheries research in East Africa. The facility was later passed over to the first East African Community (EAC), and after the break up of the first EAC in 1997, it evolved into UFFRO and became responsible for fisheries research in Uganda. The Kajjansi Aquaculture Experimental Station was previously under the Department of Fisheries Resources in the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) up to 1994 when it became incorporated into FIRRI.



Laboratory (right) and **conference** (left) **blocks** at the headquarters of the Fisheries Resources Research Institute (FIRRI), Jinja



Concrete ponds as alternatives to earthen ponds.  
Experimental work at Kallansi ARDC

## The contribution of FIRRI to increased and sustainable fish production

The national development objective is poverty eradication. The overall fisheries sector goal is to ensure increased and sustainable fish production and utilization by properly managing capture fisheries, promoting aquaculture and reducing post-harvest losses. FIRRI contributes to the fisheries sector goal by providing information to guide sustainable management of capture fisheries resources and development of aquaculture. The Mission of FIRRI is to contribute to poverty eradication, food security, conservation of the natural

resource base and sustainable livelihood of fishery dependent communities by providing improved technologies, methods and advice for increased and sustainable fish production and utilization, a healthy and productive water environment, and people centered policies for sustainable fish production.

### **Constraints to increased sustainable fish production in Uganda**

Major threats to sustainability of capture fisheries include:

- a) *declining fish catches and fish species diversity;*
- b) *over-fishing;*
- c) *use of destructive fishing gears and methods;*
- d) *inadequate information on fish stocks and fish species diversity;*
- e) *declining diversity and low productivity and shifts in algae and invertebrate food of fishes;*
- f) *pollution and degradation of the fish habitats;*
- g) *infestation by water hyacinth and other aquatic weeds;*
- h) *inadequate investment skills among fishers;*
- i) *limited commitment and involvement of fisher communities in management of fisheries and the aquatic environment;*
- j) *inadequate dissemination and limited application of research results.*

The main constraints to increased aquaculture production include:

- a) *inadequate quality fish fry (seed),'*
- b) *lack of appropriate feeds;*
- c) *poor pond management practices;*
- d) *limited variety of cultured fish species;*
- e) *fish stunting;*
- f) *Small scale non-commercial enterprises;*
- g) *inadequate information on economic viability of aquaculture;*
- h) *inadequate dissemination of information; and*
- i) *limited application of available technologies into commercial farming.*

The above checklist can be used to apply investments into researchable areas.



## The Functions and Objectives of FIRRI

The functions of FIRRI are to generate, package and disseminate scientific information, build capacity and manage research for: Sustainable exploitation and management of fish stocks; Conservation of aquatic biodiversity; Understanding the dynamics and productivity of algae and invertebrate food offishes; Prevention of pollution and eutrophication (over-fertilization) of the fish habitat; Control of invasive weeds especially water hyacinth; Enhancement of aquaculture production; Ensuring fish quality and safety; Development of options for optimization of socio-economic benefits from fisheries; Development of options for co-management; and providing technical guidance into development of action plans, policies, laws and regulations for management of fisheries and the fish habitat.

The above functions are currently implemented according to the NARO Strategy and Medium Term Plan (MTP) for the period 2001-2005 in line with the Plan for Modernization of Agriculture (PMA), and alongside the principles of the National Agricultural Advisory Services (NMOS). Research and technology development in Uganda has been foreseen as the first among the seven pillars of PMA. In addition to this pillar, FIRRI through generating and disseminating information to guide sustainable development and management of fisheries resources and the fish habitat contributes to the sixth pillar of PMA, "sustainable natural resources management".

## The National Projects Implemented by FIRRI

Management of this project is divided into sub-projects focusing on capture fisheries production systems namely: Victoria basin lakes; Kyoga basin lakes and rivers; Lake Albert and Albert Nile; Lakes Edward and George; and small water bodies. This systems approach is a step towards decentralization of capture fisheries research to major fish production systems. At least six disciplines have so far been identified as being crucial in fulfilling the capture fisheries research objectives to address the identified production constraints. These include: Fish stock assessment; Fish biology and ecology; Physico-chemical conditions and algal dynamics and productivity; Invertebrate food studies; Aquatic plants and weeds; Fisheries socio-economics and Post-harvest fisheries. These represent the key aspects examined in the different systems and the key components in the model towards understanding and sustainably managing fisheries resources to *overcome poverty*.

The second project focuses on increasing and sustaining fish production and utilization through enhancement of aquaculture production and targets:

*"Enhancement of Fish Farming Through Improved Fry Production and Feeding"*. Research in aquaculture focuses on improving Fry production; and Feeding and pond management as the main disciplines. Aquaculture research concentrates on promoting and improving culture of the two important aquaculture species, the Nile tilapia (*Oreochromis niloticus*) and the catfish (*Clarias gariepinus*). Efforts are being made to introduce the originally popular food fish species such as the Ningu (*Labeo victorianus*) and the native Lake Victoria Ngege (*Oreochromis esculentus*) into aquaculture, and promoting culture of ornamental fish and new species.

In order to fulfill its objectives, FIRRI is implementing two projects under the NARO MTP. The first project focuses on capture fisheries and targets, increasing and sustaining fish production and utilization through: *"Management Of Fish Stocks, Biodiversity And Environment Of Aquatic Systems"*. FIRRI's Strategic Research Plan is dynamic and already accommodates other projects within the framework of the entire National Agricultural Research Systems.

The key outputs from FIRRI's research projects are technical guidelines in the form of books, booklets, fact sheets, brochures, posters, CDs, video films and other information dissemination materials to be used by service providers, policy makers and resource users to develop best practices, action plans, policies and regulations for management of capture fisheries resources sustainably and for enhancing aquaculture production. The eventual and final impact of this effort are expected to be fishery dependent-communities who are adequately informed to sustainably exploit fisheries resources and manage the fish habitat to overcome poverty and sustain their livelihood on fisheries. Technical Guidelines are disseminated through groups or individual districts, sub-counties and villages around a particular production system. The functional organization and linkages for fisheries research is shown in the accompanying organisation flow chart.



The FIRRI Information & Data Centre

Since 2003 and early 2004, a reform process in Uganda aimed at restructuring the entire National Agricultural Research System (NARS) led to recognition of novel ways of conducting agricultural research (including fisheries) in the country. It is considered that in order to:

- 1). Guarantee food security, stable income and improved quality of life that poor households derive from strategic exploitation of crops, livestock, fisheries and forest resources;
- 2). Provide and or support gainful employment in all sectors of the economy; and
- 3). Promote sustainable use and management of natural resources,

NARO'S research has to realign its objectives according to the Plan for Modernization of Agriculture (PMA) along thematic lines. These are:

- Theme 1. Understanding people, their livelihood systems, demands and impact of innovations;
- Theme 2. Enhancing innovation processes and partnerships;
- Theme 3. Enhancing integrated management of natural resources;
- Theme 4. Technology options that respond to demands and market opportunities;
- Theme 5. Enabling policies and linking producers to markets.

Out of these NARO-wide five themes, FIRRI will lead in the following NARS identified projects:

- Theme 1. Determination of environmental status of aquatic systems
- Theme 2. Developing fisheries co-management across the fisheries sector
- Theme 3. Inventory, collection, characterisation and conservation of fisheries genetic resources.

Generation of knowledge and technologies for the management of the ecology of aquatic systems, fishing methods and fish farming and harvesting.

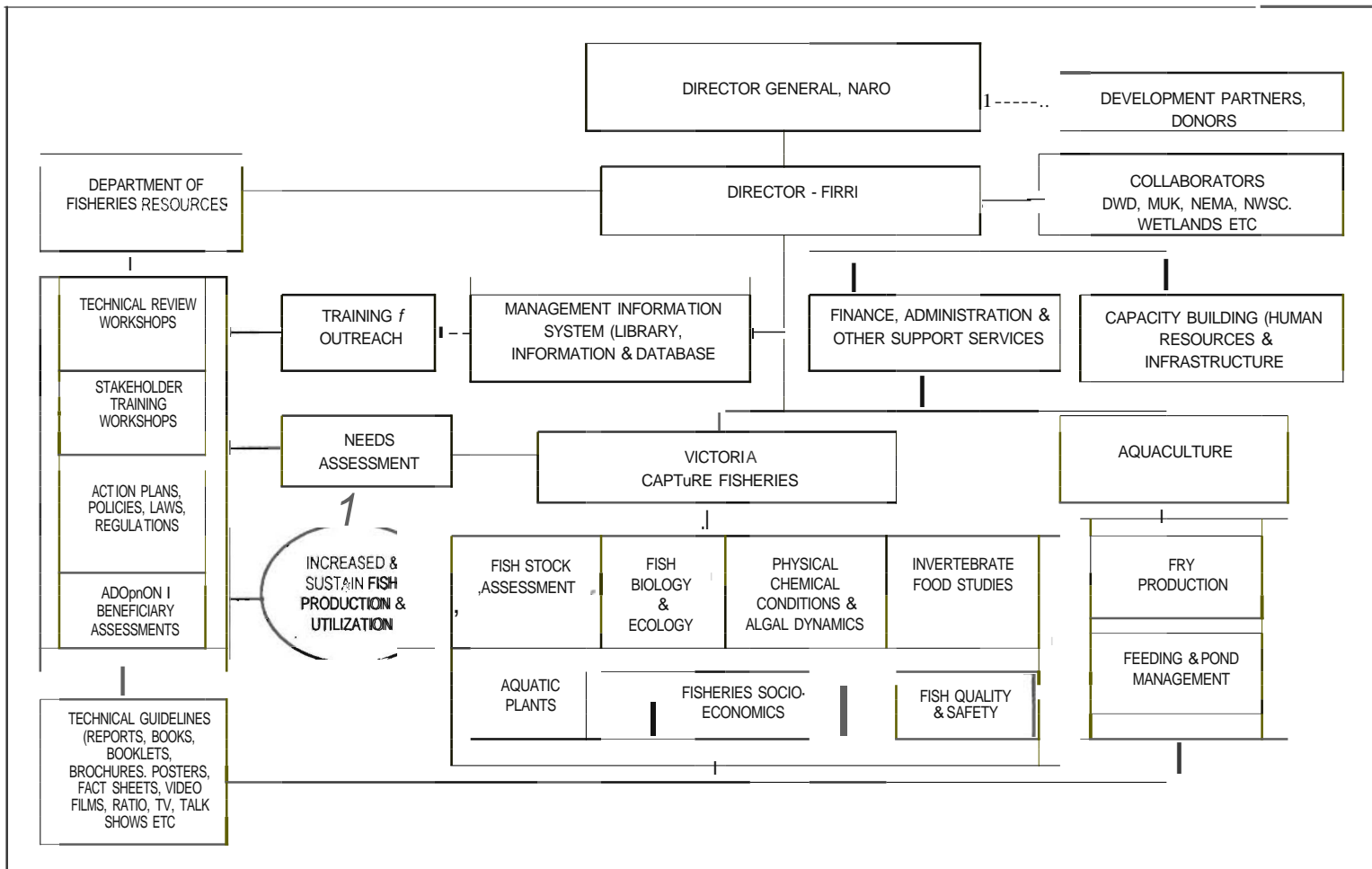
Generation of knowledge and technologies that ensure sustainable utilization of fish stocks (capture fisheries)

Generation of knowledge for the management of aquatic weeds and their hot spots in different aquatic systems

Theme 4. Identification of fish feeds and seed for commercial fish production

Theme 5. Analysis of the impact of existing national and local government policies (i.e. decentralisation, taxation, privatisation of input and agricultural advisory service delivery, by-laws and regulations) on agricultural production and marketing

Fig. 1.1. Organisational flow chart of FIRRI and its linkages to mandate areas and clients.



Synthesis of biophysical and socio-economic research outputs to draw recommendations for policy formulations.

Analysis of domestic and world market demand and supply for different commodities.

Analysis of domestic and world demand and supply for different inputs.

Analysis of marketing systems for different commodities.

Analysis of **input** marketing systems.

The identified projects require establishing partnerships at local, national, regional and global levels.

As the research has to remain dynamic, it will require FIRRI to continuously update its Functional Organogram (Fig. 1.1) to face new challenges.

The process of generating and disseminating information involves identification of stakeholder needs, generating the required information, packaging and discussing the information with stakeholders, synthesizing the information and disseminating the synthesized information to service providers and resource users. FIRRI continuously strives to provide timely and accurate information by developing an Information and Database system that in time **will** feed into the institute's website. In addition, scientific information is presented to the international community through scientific publications and workshops.

One of the ways for developing and managing fisheries resources is by ensuring that fishery dependant communities and other stakeholders have the required information. FIRRI has set up the process of producing Technical Guidelines for each sub-project or discipline area as appropriate. Production of the Technical Guidelines is undertaken in two major phases. The first phase consists of research and production of detailed technical reports covering the different disciplines. The discipline technical documents for a specific water body are then compiled into a monograph covering the fish production system. These monographs form a one-stop center on technical Information on the water system. Key observations and recommendations from each monograph are then summarized into technical guidelines in a form, which should be understood by policy makers at different levels. This monograph focuses on the Victoria Basin Lakes.

## The Victoria Basin Lakes

The Victoria basin lakes consist of Lake Victoria and the satellite lakes within the lake Victoria basin. The satellite water bodies include the Kookilakes (Kijanebalora, Kachera, Mburo, Nakivali) and associated wetlands, the Nabugabo lakes that include Lakes Nabugabo, Manywa, Kayugi and Kayanja and associated wetlands and streams.

Lake Victoria has gone through major changes which include: Collapse of the native fishery which was dominated by native tilapiines species; Introduction of native fish species; Depletion and drastic decline in diversity of the native fish species due to predation by one of the introduced species Nile perch; Degradation of the aquatic environment including infestation by foreign water weed, the water hyacinth. Alongside these negative changes there have been drastic increases in harvestable fish stocks based on the introduced Nile perch which has stimulated establishment of fish possessing plants and a lucrative fish export market. This has changed the dynamics of the fishing industry around Lake Victoria.

### Exit strategy

Major challenges remain. Updating this monograph requires that the fisheries, environment and socio-economics information base is updated through monitoring research. This has been started on Lake Victoria through a regional mechanism- the Lake Victoria Fisheries Research Organisation (LVFO). However, Uganda's fish production systems (the aquatic landscape) comprises of 20% of the total land area that includes major production systems (e.g. Lakes Albert, Kyoga, Edward, George) and numerous smaller lakes and wetlands where the science base is weak to non-existent.

Information gathering on the other aquatic systems is sporadically undertaken but much more is needed to address issues such as the Millennium Development Goals (MDGs), various conventions and protocols (e.g. Biodiversity and Wetland Conventions) that can translate into sustainable development. It is here that FIRRI will look to the already established partnerships and encourage others to contribute.

The increasing importance of the fisheries in Uganda is as a result of three divergent scenarios:

- (a) Fish exports
- (b) Internal consumption (Domestic Demand)
- (c) Environmental degradation

Apart from these scenarios, there is also increasing recognition of biodiversity conservation and population growth. Therefore, FIRRI has consolidated constraints to the sustainability of the fisheries and aquatic production systems as:

- a) Collapse in the traditional native fisheries,
- b) Potential collapse in the fisheries based on introduced fish species,
- c) Declining biodiversity,
- d) Deterioration in the environment of aquatic systems, e.g proliferation of water hyacinth and eutrophication.
- e) Declining socio-economic benefits,
- f) An increasing population in the catchments of production systems,
- g) Availability and access to information and databases,
- h) Lack of drive to invest in commercial fish farming.

These constraints have been fully integrated into the National Agricultural Research System and will sustain diverse investment interests.