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IMPROVEMENT OF AQUACULTURE IN UGANDA

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ABSTRACT

If Uganda is to feed her ever increasing population, she has to focus attention on increasing high value animal protein production. One possible way to achieve this goal is to improve the existing fish-farming industry in the country. Worldwide, aquaculture is increasingly recognized as a viable and profitable enterprise. The aquaculture industry continues to grow and will supply an increasingly larger proportion of fishery products for the needs of growing populations. Because many populations of fish have been poorly managed, the yield of natural fisheries is often unpredictable. We must recognize that, like any natural resource, our fisheries are finite. The people have noticed that the fish stocks worldwide show signs of depletion either through irrational exploitation of the resource and/or deterioration of the aquatic environment. In contrast, the full potential for aquaculture in Uganda is far from being realized. Farmers and institutions express growing interests in the industry. However, the existing facilities for aquacultural production and research in Uganda, and for most of Africa, are inadequate. Available fish hatcheries cannot satisfy the demands of the possible farmers. Many native species which may have aquacultural potential in the region need to be studied. Among the popular fish which could be targeted for farming are the native catfishes (*Bagrus* and *Clarias* spp.), Ningu (*Labeo victorianus*) and the Lake Victoria tilapia Ngege (*Oreochromis esculentus*) which have almost disappeared from the major lakes and rivers. Research efforts should be concentrated on conservation, selection and breeding of desirable native fish species which are of commercial importance. Stocks adapted to the climatic conditions of the region need to be developed. The Government will be called upon to play a leading role in providing resources to extend the existing infrastructure and facilitate the establishment of more hatchery centers in the country, in encouraging the development of trained manpower to impart technical advice through extension services, and in providing financial support to farmers to implement an aquaculture production program. Improvements in the practices of aquaculture would ensure an adequate supply of cheap animal protein for present and future generations, as well as providing possibilities for conserving the gene pool of native species threatened with extinction, and restocking into the wild.

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INTRODUCTION

The husbandry of aquatic animals has been practiced for centuries throughout the world. The ancient Egyptians and Chinese cultured tilapia and carp long before the Christian era. The Japanese, modern leaders in aquaculture technology, have a long tradition of aquatic husbandry. All of these traditional technologies have benefited from the scientific approach to aquaculture of the twentieth century.

The rising protein needs of an expanding world population will not be met by traditional capture fisheries. Although the maximum exploitation of aquatic resources predicted by some authorities, as measured by worldwide gross tonnage from natural stocks, has not yet been reached, many species have been fully exploited. Harvested biomass from these species is declining as populations are overfished. This trend can only continue and will result in diets of lesser diversity and quality.

The same patterns can be seen locally in the harvest from fisheries of the Lake Victoria basin. Fish have always been a major protein source in the diet of Ugandans. Fisheries supplies in rural Uganda have declined, and the cost of fish as a source of protein has increased. This has lead to a decline in the use of fish within the traditional Ugandan diet. Today, it is increasingly evident that, if we wish to maintain aquatic foods as a major component in our diet, we must intervene in the natural processes, manage dwindling natural aquatic resources carefully and expand our ability to utilize species not yet exploited to the maximum benefit of mankind. Many species previously supplied only by fishing are now being cultured and the production of species with long histories of culture is now being expanded as rapidly as technology is allowing.

Aquaculture using modern culture practice has, thus, drawn increasing attention from many quarters as a viable alternative for fisheries production, in both developed and less developed countries (Pillay, 1977; 1979). Aquaculture, though certainly no panacea, can make a significant contribution to the production of animal foodstuffs for domestic consumption and perhaps even for export markets. Worldwide, the industry is viewed by many observers as finally reaching a phase of rapid growth after lagging behind expected performance in some countries. Within Uganda, however, aquaculture is struggling to develop. Aquaculture represents a significant potential dietary and economic contribution to Uganda, but one whose potential can be reached only with a commitment to overcome the problems which are hindering expansion of this industry.

As the limits of natural production sources are approached, incentives develop which encourage the development of domesticated sources of aquatic food products. With human population approximately doubling every 30 years, demand for animal protein sources can be anticipated to increase substantially. The need arises then to shift from an almost total dependence on traditional sources of fishery products to dependence on domesticated sources, which can be achieved only by increased development of aquaculture production. We have assumed that population growth and the need for economic development must be accepted, and consider how the development of alternative approaches to fisheries production can contribute to the economic and dietary requirements of Uganda in the next century.

UGANDA AQUACULTURE: THE PROBLEMS

Dwindling natural fishstocks

If Uganda has to meet its food requirements in the 21st Century and beyond, she has to focus much attention on new methods of food production. As mentioned above, the country cannot continue to depend on the wild stocks of those fishes which have traditionally been used. Natural stocks of virtually all of these species are dwindling very fast. Evidence suggests that even those which have not yet shown significant declines in catch are being negatively affected by increased fishing, and are likely to show declines soon. One practical alternative for Uganda to compensate for declining natural harvest is to invest in aquaculture production.

The reasons for the decline of the fisheries of the Lake Victoria basin are complex. They ultimately can be traced to increased pressure on the environment caused by human population growth and include, among others:

- overfishing because of changed fishing technology
- harvest of fish during reproductive periods
- introduction of exotic predators and competitors
- changing climate
- environmental deterioration of Lake Victoria and its tributaries

It is useful to consider these factors in detail. Reasons advanced for the decline of the natural fish stocks worldwide range from mismanagement of the resource to the degradation of the aquatic environment during the last three decades or so. These same reasons can be applied to the decline of fish stocks in Uganda:

Fishing practices. Some of the stocks were overfished through use of illegal fishing gear, while others were severely affected when fishing occurred during their peak breeding season (Okaronon et al., 1985). The latter practice particularly affected the anadromous (migratory) species of Uganda, such as the Ningu (*Labeo victorianus*) and the mormyrid species (Kasulu) in Lake Victoria.

Introduction of exotic species. The introductions into Lake Victoria of the Nile perch (*Lates niloticus*) and the Nile tilapia (*Oreochromis niloticus*) left their own unique and devastating impact on the fishery of the lake. The exotic tilapia succeeded in out-competing many of the native stocks, including several important food fishes, such as the Ngege (*O. esculentus*). The Nile perch, through its voracious predation, has almost wiped out many of the small cichlid fish species which at one time constituted more than 80% of the lake's ichthyomass (Kudhongania and Cordone,1974; Witte et al., 1992).

Climatic changes. The aquatic environment of Lake Victoria has deteriorated in the recent past due to a number of events. Some of the factors are global, for instance global warming, increases in the level of carbon dioxide in the atmosphere and the reduction in the ozone layer.

Environmental modification. On the local scene the inland water systems of Uganda have undergone successive changes since the mid-fifties due to modification of the drainage area, invasion by introduced species (both plants and animals), and the increasing biological and physicochemical changes in the environment. The organic pollution and eutrophication of Lake Victoria waters can be partly attributed to the increase in the human population, with its accompanying urban and industrial activities and agricultural production. The foodweb of the ecosystem has been markedly altered. The massive reduction of the cichlid haplochromines of Lake Victoria, especially the algal grazing species, caused by the predation of the Nile perch, allowed the phytoplankton biomass to accumulate. Frequent algal blooms now occur, which are often associated with fish kills. Primary productivity of the lake has also gone up as a result of high nutrient load coming from known land point sources and precipitation. The accumulation of organic material and other nutrients has created anoxic conditions in most of the areas of the lake naturally inhabited by fish. The recent invasion of the notorious water weed, the water hyacinth, has further accelerated oxygen depletion in the productive littoral zone of the lake. Furthermore, the algal composition of the lake has changed. There are more blue-green algae (cyanobacteria) being produced and some of them are known to be toxic and unpalatable to fish (Mugidde, 1993).

All the cited changes do not predict a bright future for the production of fish in our waters. It would appear that the only viable alternative, as far as fish production in Uganda is concerned, is to completely swing to aquaculture as a reliable source of fish.

The aquacultural infrastructure: state of the Fisheries Experimental Station

Aquaculture has great potential in Uganda. Permanent (year round) streams exist throughout the country which can be used as a water source for production facilities. The demand for fish as a food within Uganda is great, while the supply has declined. Prices increase. The distribution of native fish supply is not uniform, since the major lakes and rivers are confined to the south and west of Uganda, and over 60% of the country is out of easy reach of fish products.

Aquaculture research in Uganda is still at an early stage of development. The Fisheries Experimental Station at Kajansi is the only center in the country where fish breeding trials are conducted. It is part of the Ugandan Fisheries Research Organisation, but also interacts with the Department of Fisheries and the Department of Environmental Protection at Makerere University. There are several components to the agricultural mission of the Kajansi station, including:

- encouraging the development of aquaculture
- delivering extension services to possible producers
- research to try to domesticate some of the wild species of fish indigenous to Uganda
- the expansion of the use of mirror carp and grass carp as Ugandan aquacultural forms in pond culture in Uganda
- raising fish fry in hatchery ponds to be supplied to interested fish farmers

The station was intended to serve as a national resource, providing support for the aquaculture industry in Uganda. At one time, this goal was well achieved. However, in the 1970s, the politico-economic upheavals resulted in an interruption of the continued development of the objectives of the Research station.

As with many aspects of the scientific development of Ugandan agriculture, the Fisheries Experimental Station at Kajansi was not spared by the period of stagnation and deterioration in recent history. Much of the facility was neglected and went into disuse and deterioration. Today, the station is recovering, with rehabilitation work begun a few years ago when the HARE Project (funded by the World Bank) was implemented. Ponds and raising areas are being rehabilitated, and the laboratories have begun to be reequipped. Presently, a few fish species are raised at Kajansi ponds for fry production. These include primarily the Nile tilapia and the mirror carp. Currently, none of the indigenous Ugandan fish food species is being reared at the facility in Kajansi. On local predatory fish, *Bagrus docmac* (Ssemutundu), is stocked to control pond populations of tilapia, a procedure which acts to increase the size of mature adult cichlids by decreasing competition and increases the useful production in the culture ponds. According to the report of the Officer In-charge, about 20,000 fish fry of Nile tilapia and carp were supplied to farmers in 1994. However, most of these farmers came from ten districts located in the south of the country and the expansion of the industry elsewhere in Uganda is not adequately supported. No hatchery centers are maintained up-country, thus reducing the number of prospective farmers who would be interested in the venture. No other aquacultural facilities exist in Uganda.

In evaluating the future role of the Kijansi Fisheries Experiment Station in fostering the aquaculture industry of Uganda, a number of questions must be posed:

- What educational and research programs are currently being provided by Kijansi?
- What should be the hatchery's role in the future?
- What research role should Kijansi play?

And finally, for an adequate evaluation of the future of the industry itself, we must ask:

- What is the importance (in terms of monetary value) of each species, whether indigenous or introduced?

POSSIBLE SOLUTIONS

Policy improvements. If aquaculture is going to be improved in Uganda, there are a number of positive actions that will have to be considered. Each will involve an initial investment, and each seems to have the potential to provide more long term benefit than initial cost.

Improve the breeding center at Kajansi. If this industry is to be encouraged, changes must start by upgrading the central facility of the country. Almost the entire infrastructure needs to be overhauled if funds permitted. In order to carry out contemporary aquacultural practices, laboratories need to be equipped with appropriate instruments, chemicals, aeration and water systems. This would allow the manipulation of stock to produce faster growing individuals adapted to the Ugandan aquacultural environment. The library of the Fisheries Experiment Station should be established as a serious resource, and stocked with relevant books and periodicals.

Improve the numbers, qualifications and training of staff (both professional and support). As with many facilities for Ugandan agricultural development and research, the station suffers from understaffing, particularly among the research cadre. If noticeable achievements in aquaculture are going to be made and the industry encouraged, an adequate, well-trained manpower base will have to be put in place. Important differences exist between the aquaculture training requirements for each staff level. Senior and middle-level staff require specialized postgraduate training of a practical nature. Unfortunately, this is currently not available at our national institutions. The lower-level field staff also require on the job-training in aquacultural practices. Individuals should be trained in hatchery management, improvement in genetics of brood-stocks, fish feeds formulation, water quality monitoring, diagnosis of disease infections and their control, extension service coordination, and information storage/dissemination methods.

Expand extension services. To promote the development of aquaculture the trained staff of the Fisheries Experiment Station must be organized to deliver extension services using direct and indirect means of contact with the farmers. These extension services must be backed by technical services with the capability of making technical improvements through research and passing these improvements on to the grass-

roots level, the farmers. The service should be able to respond to new ideas through direct farmer contact, group representatives and internal evaluation. Educational services must be expanded. Currently, the National Agricultural Research Organisation has made available "A Guide for Fish Farmers" which provides rudimentary information for individuals considering aquaculture on their lands. Such material should be expanded, and backed by trained extension persons who can assist the local farmers.

Expand governmental encouragement for aquaculture. Since fish culture is still at an early stage of development in Uganda, positive government action is necessary to create suitable conditions for its development. This action should include the encouragement of farmers to view aquaculture as an attractive alternative to other activities. Government action is considered necessary at two levels:

1. Direct intervention in aquaculture.

2. Positive policy-making to create a suitable socioeconomic environment for the farmers.

Direct government intervention is required for instance in the general promotion of aquaculture research training of personnel, seed stock production and extension services. Promoting the correct socioeconomic environment for aquaculture development will be important. One way is to provide sufficient credit facilities and investment funds to the farmers because the initial capital needed to open up a fish farm is usually high. It is clear, however, that the expected future declines in natural fish food stocks should result in a very positive return on this investment, both monetarily, and in terms of the food resources which aquaculture will provide for the country.

Encourage aquacultural research in Uganda. Research which should be encouraged includes the examination of nutritional and environmental conditions specific to Ugandan aquaculture, in order to maximize potential production by improving its efficiency. Species which are currently being used, such as Nile tilapia and carp, should be evaluated to see whether the present stocks are performing well under Ugandan cultural conditions.

Develop native food fishes as an aquacultural resource. It is also very important that funds be raised to support research on the preservation and breeding of desirable native fish species. Unfortunately, many of these species have undergone declines in population sizes or have almost disappeared from the lakes and rivers. It is vital that these be evaluated for their aquacultural potential, especially since they are already adapted by evolution to the climatic conditions of the region. Many of these species provided important traditional food resources to Ugandans in the past, but have now become scarce because of their declining populations. Among the popular species which could be targeted for development of domesticated farming stocks are the native catfishes (*Bagrus* and *Clarias* species), Ningu (*Labeo victorianus*), mormyrids and Ngege (*Oreochromis esculentus*).

Encourage nontraditional applications of aquaculture. It should also be kept in mind that the "tropical fish" industry in Europe and North America could represent a significant economic market for local nonfood fishes. Given the decline of many of endemic Ugandan species, some thought should be given to the development of a local industry aimed at raising fish for export to the aquarium trade. As a start, a few selected species of the surviving *Haplochromis* cichlid community should also be seriously considered for rearing at the experimental station with aims of conserving the species gene pool and promoting continued species diversity. Some of the haplochromines could be maintained as ornamental fish with future prospects for the export aquarium market as well as possible restocking of waters which cannot perpetuate their own populations. Given the current emphasis in the scientific literature on preservation of biodiversity, both for intellectual reasons and with the knowledge that many species turn out to have economic value (as sources of food or biological products), it is important to consider the potential value of our aquatic resources, and act quickly to preserve them.

The senior author sincerely hopes that at the end of his training in the field of aquaculture he will be able to contribute new insights for Ugandan fisheries management and promote the industry of fish food production in Uganda and make a humble contribution to the national goal of meeting demands for an adequate, cheap and protein-rich source of animal food for her population.

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