A community project for aquaculture in Kenya

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Abstract

Small-scale fish farming in Kenya has often been unsuccessful because lack of expertise has resulted in low fish yields and a poor economic return. Moi University recognised that, if fish farming was to realise its potential, locally proved techniques were urgently needed for the successful development of aquaculture. As part of its mission in out-reach, the University has created a demonstration fish farm for teaching and research. The farm comprises 47 ponds, covering a total area of 2.5 ha, supplied with water from a spring-fed reservoir. To bring participatory benefits to the local community, instead of using earth-moving machinery during the construction phase, the University opted to use manual labour and thus provide benefits of income, experience, a sense of project ownership and a ready market for the fish produced. The fish farm is used to train university students, fisheries officers, extension workers and fish farmers in aquaculture techniques. Courses focus on pond design, construction and management alongside help with business plan preparation. Results of research projects and the demonstration programme are tested by fish farmers elsewhere. This logical step for transferring research-based technologies has enabled assessment of costs and benefits under local operating conditions and, for most participants, the outcome has been an increase in yield and profit.

Introduction

Aquaculture in Africa can form an attractive and important component of rural livelihood. This is especially so where catches from wild fisheries are limited by increasing population pressures, environmental degradation or loss of access (IIRR *et al.* 2001). Fish farming can contribute to the alleviation of food insecurity, malnutrition and poverty through the provision of food of high nutritional value, income and employment generation, decreased risk of monoculture production failure, enhanced aquatic resource management and an overall increase in sustainability of farming in general (e.g. FAO 2000; Prein & Ahmed 2000). Also, in the context of the rural poor, aquaculture often complements catches from traditional fisheries.

Generic technologies for sound aquaculture production exist and many of the technical aspects of aquaculture are relatively well developed. There is, however, a knowledge gap between what is known globally and what is available to farmers. Weak rural extension systems and a lack of local examples of intensified aquaculture often limit both the ability and willingness of farmers to risk intensification. According to Halwart *et al.* (2003), more emphasis is needed to:

- favour systems which use readily available species and local materials;
- decentralise fry production and trading networks;
- improve culture systems for species that are preferred for local consumption; and

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- adapt and improve these systems through farmer-based learning and promoting the results through participatory approaches.

The challenge is to create an enabling environment for optimising the potential benefits of aquaculture. People-centered development and extension management approaches encourages capacity building that focuses on culture systems for species that feed low down in the food chain and which provide the low-cost products favoured by poorer rural communities (Subasinghe 2003). To ensure overall sustainability of aquaculture development, creation of the enabling environment involves:

- providing appropriate technology, policy, legal and institutional frameworks;
- involving all stakeholders in decision making, policy planning and management;
- facilitating access to key resources including information, materials and money.

Small-scale fish farming (FAO 1999) has had many false starts in sub-Saharan Africa, dating back to the beginning of the twentieth century. Pessimists still consider aquaculture to be a risky enterprise producing low yields of fish and a poor economic return on cash and labour investments. Likely reasons include lack of experience in fish breeding and slow uptake by farmers of the technology of pond fish production. In Kenya, fish farming has a history of more than 50 years, yet the culture of tilapia and catfish remains primarily at subsistence level only. The potential for economically viable and sustainable aquaculture has remained largely unrealised. Recently, however, the creation of the Moi University Fish Farm has facilitated a change. By a combination of example and extension, there has been a widespread adoption of new skills and technologies which has transformed many low-yield fishponds into productive systems.

Moi University Fish Farm

Moi University was established in 1984 to meet the need for a second university in Kenya and is mandated to train skilled people in science, technology and development. To comply with this mandate, Moi University provides high-level teaching, research and outreach services. In fulfilling the mission in outreach, it was recognised that development of fish farming in Kenya was in dire need of locally proved methods in aquaculture for use in extension. Accordingly, a demonstration, teaching and research fish farm was constructed and this is now the largest facility of its kind in East Africa. Its site location is shown in Figure 1.

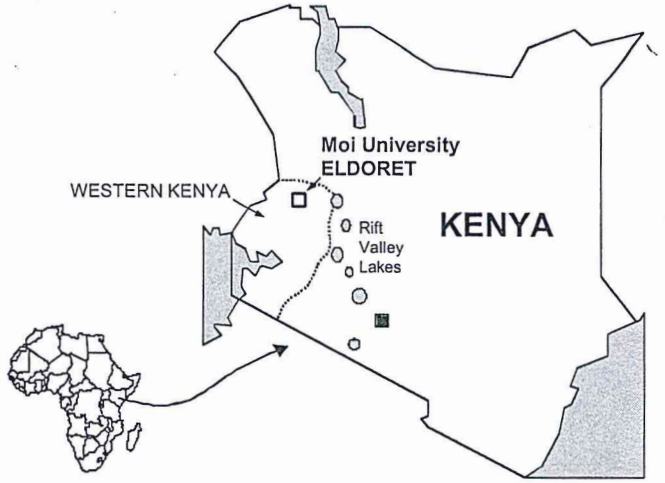

Figure 1: Location ( ) of Moi University Fish Farm, Kenya

The Moi University Fish Farm was designed to fulfil a number of roles:

- To be a practical facility in support of fisheries students studying aquaculture;
- To act as a demonstration unit to promote the potential of freshwater fish farming to community leaders, government officials, extension workers and entrepreneurs (this to be achieved through practical training courses, visits, 'open days' and the dissemination of information);
- To serve as a regional centre for research into appropriate aquaculture methods and for the development and assessment of equipment, feeds, husbandry practices, etc., including economic evaluations of production methods;
- To function as a supplier of juvenile fish to farmers in the region to both generate local revenue and assist fish farming development;
- To provide applied research opportunities for faculty members and visiting scientists.

In order to satisfy the range of purposes outlined above, considerable attention was given to both the design and future operation of the fish farm (FAO 1996 & 1998), the main facilities comprising a hatchery, quarantine unit and fish ponds alongside supporting facilities of a seminar room, laboratories, workshop and offices. To keep the risk of problems from fish diseases and parasites to a minimum, water supply to the ponds is from a 1.2 ha spring-fed reservoir. The ponds themselves were designed in accordance with FAO recommendations (FAO 1992 & 1995) and have the following important features:

- Filled by gravity inflow to avoid the need for pumps;
- Fully drainable with adjustable pipework to enable effluent to be discharged from any chosen depth within the pond;

- Sloping sides to enhance natural productivity;
- Fertile surface soil, set aside during pond construction, used to cover the bed of the ponds;
- Effluent to be intercepted by *Cyperus papyrus* swamp prior to entering the exit stream.

Several sizes of ponds were constructed to hold fingerlings, fish being grown on and fish held as broodstock. Total pond area is 2.5 ha including 25 ponds of 100 m^2 surface area, 6 of 300 m^2, 4 of 1000 m^2 and 2 of 2000 m^2. A schematic plan of the site layout is given in Figure 2 and a general view is shown in Figure 3.

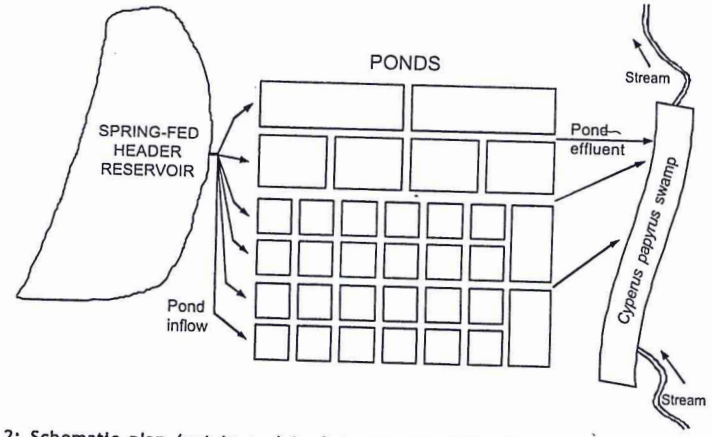

Figure 2: Schematic plan (not to scale) of the layout of Moi University Fish Farm [reservoir surface area is 1.2 ha and total pond area is 2.5 ha]

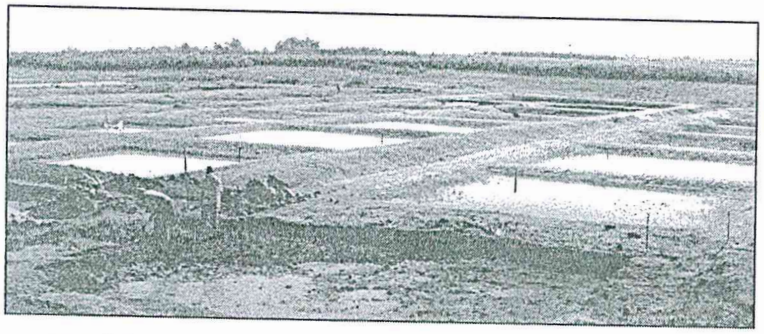

Figure 3: General view of Moi University Fish Farm in June 2003 [in the foreground are manual labourers digging a pond and in the background is the *Cyperus papyrus* swamp which intercepts pond effluent] (Photograph: Chris Adams)

Funding for the project was primed with an allocation from the Capacity Development component of the Moi University budget. Thereafter, significant external funding was secured in the context of collaborative support. Principal donor organisations included World Bank via the Lake Victoria Environment Management Project (LVEMP), USAID and host Government via the Pond Dynamics/Aquaculture Collaborative Research Support Programme (CRSP), and the Canadian International Development Agency (CIDA). The goal of these funding bodies is to increase, in a sustainable manner, the capacity of developing countries to educate and train the human resources required to meet their priority development needs.

An important feature of the construction phase was the decision to involve local people as much as possible. Firstly, instead of using external consultants, suitably qualified staff from the Fisheries Department of Moi University were asked to manage the project in-house. This gave them an opportunity to add considerably to their personal professional development. Secondly, instead of contracting expensive machinery, manual labour was used throughout. The benefit of this approach for the community was the provision of employment and income plus experience and a sense of involvement. Also, a ready market for any fish produced was created. During 2001, 22 ponds were dug, adding to 8 that had been constructed previously, and the reservoir site was surveyed and marked out. Also, work on feeder pipes and drainage canals was started. During 2002, most of the remaining ponds and the header reservoir were completed. World Bank representatives visited during the construction phase and expressed satisfaction with the project and the choice of site.

Participatory projects

Participation at all levels is crucial to the implementation of the aquaculture research and outreach mission of Moi University. Recent participatory research projects include:

- development of economically feasible feeds for semi-intensive culture of tilapia, (*Oreochromis niloticus*) using locally available agricultural by-products (Gitonga *et al.* 2001);
- techniques for the production of *Clarias gariepinus* fingerlings as baitfish for the Lake Victoria Nile perch longline fishery (Ngugi *et al.* 2001a);
- evaluation of growth and reproduction performance of three strains of Nile tilapia found in Kenya for use in aquaculture (Omolo *et al.* 2001); and
- regional enterprise budget, business plan development and economic risk analysis of tilapia production in Kenya (Muchiri & Engle 2001a; Muchiri & Engle 2001b).

In the context of outreach and extension, programmes of aquaculture training are provided for fisheries officers, university students and fish farmers (Ngugi *et al.* 2001b; Veverica *et al.* 2000; Veverica *et al.* 2001a). In addition, the training activities are complemented by on-farm trials which enable local farmers to evaluate alternative aquaculture technologies. Case examples of community, research, training and farm trial benefits are given below.

Case examples

Community benefit

In opting to use manual labour for the construction of ponds, instead of earth-moving machinery, up to 80 young labourers were employed at any one time. Providing work for many young people found favour with the area administration as well as the individuals concerned. The labourers quickly adopted a sense of ownership over and above the direct reward of income. The opportunity to earn money was important nonetheless. A case in point was a twenty-two year old girl, recently graduated from high school, whose examination results were being withheld pending the clearance of outstanding fees. Wages for work done at the construction site of the Moi University Fish Farm enabled her to pay for the release of her results.

Research extension

Researchers at the Moi University Fish Farm used a technique for the induced spawning of the African catfish (*Clarias gariepinus*) using pituitary hormone. Subsequently, mature catfish previously raised from fingerlings were successfully spawned. The significance of this successful trial is that the fish farm is now in a position to develop quality catfish fry for growing on by fish farmers. One recipient farmer has reared about 10,000 catfish fingerlings over a period of three months in a small 8 m x 12 m pond and these were then sold to become baitfish for the Nile perch longline fishery of Lake Victoria. The return on this type of investment is well above that from any other type of farming within reach of people in the neighbourhood.

Training

It is believed that lack of technical training has been one of the reasons behind the low output of fishponds in Kenya. Several two week and three week long training courses were provided for Fisheries Officers and Fisheries Assistants and more than 200 delegates have now attended the sessions. Training was in response to a request from the Kenya Fisheries Department to provide in-service training for their staff. Fisheries Officers, whose educational background was basic biology at university level, needed to learn about current aquaculture techniques so that they could communicate this information to fish farmers. Fisheries Assistants are of ordinary level secondary education. The courses focussed not only on pond design, construction and management techniques but, also, on business plan preparation. In addition, following requests from fish farmers, a program of farmer education days was developed. These farmer education days were continually improved, following feedback from attendees, and now approximately five such days are held annually in which up to 100 fish farmers and fisheries extension workers participate. In addition, a total of 11 Fisheries Officers have been trained at Masters level in aquaculture at Moi University.

On-farm trials

On-farm testing is a logical step in transferring research-based technologies to the farm and allows farmers to assess their costs and benefits under local conditions. It also allows project personnel and extension workers to give pond management advice specific to the location. In the on-farm trials facilitated by Moi University Fish Farm (Veverica *et al.* 2001b), 28 ponds in western Kenya (Figure 1) were stocked with tilapia (*Oreochromis niloticus*) and/or catfish (*Clarias gariepinus*) between January and March 2000. This followed a pre-trial workshop that was held to discuss and select management schemes for testing. Stocking densities were 2 fish m^{-2} for tilapia, 2 fish m^{-2} for catfish stocked with tilapia, and 1 fish m^{-2} for catfish stocked alone. Different levels of management were tested and ponds were sampled for fish growth at 4-6 week intervals. Farmers were asked to keep records such as input costs, pond water additions, fish mortality, and fish harvest data. Trials ran for 7-11 months and a post-trial workshop was held in March 2001 to summarise and evaluate the results.

Farmers learned that improved management can indeed lead to increased production, something that some doubted prior to the trials. For 21 ponds which had been harvested at the time of the workshop, the gross annualised production average was 7.4 t ha^{-1} yr^{-1}. Yields averaged 420% (163-873%) higher than those reported for the year preceding the trials. Improved yields were obtained by 80% of the farmers who participated. Average net annualised revenue was Ksh 438k (c. $6k) ha^{-1} yr^{-1}, a relatively large sum of money in terms of local, rural economy. Although farmers had not kept detailed records of expenditure during previous years, thus making genuine comparisons difficult, many of them claimed enormous increases in net revenues because they knew that they had never made money from their fishponds before. Farmers and extensionists gained a better understanding of pond management with the application of feed and fertilisers being the most important management technique learned. In addition, many people observed the trials and 24 farmers were reported as beginning to culture fish during the trial period. Others developed further their existing enterprises, e.g. one farmer extended his two-pond operation to include several new ponds and a reservoir.

Discussion

The creation of Moi University Fish Farm with its community benefit approach has been successful. This success can be witnessed as the many small-scale fish farmers who have begun turning subsistence aquaculture into profitable enterprises. The increasingly widespread adoption of recent and relevant fish farming techniques has resulted in sizeable increases in pond production and has transformed many low-yield fishponds into productive systems. Thus, direct benefit can be demonstrated as an increase in the three critical components of *knowledge, income and food.* Features of the participatory approach which proved valuable throughout the process are:

- Effective information transfer;
- Generation of collaborative funding;
- Stakeholder involvement and support;
- Implementation of best practice;
- Enhanced social welfare;
- Viable economic growth.

This paper was presented during the conference session entitled *"Delivering Community Benefits Through Fisheries Partnerships"*. O'Riordan (2004), in reviewing the prerequisites for a future that is both

environmentally and socially sound, supports the need for sustainability partnerships and purports that effective governance should be co-operative, interactive, accommodative and inclusive. The Moi University Fish Farm initiative has, seemingly, met these criteria. Moreover, its participatory approach has demonstrated potential benefits that should be applicable to any community development initiative - whether it be rural aquaculture development in Africa or creating urban recreational fishing opportunities in Europe.

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