TOPIC AREA

SUSTAINABLE FEED TECHNOLOGY AND NUTRIENT INPUT SYSTEMS

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ASSESSMENT OF GROWTH PERFORMANCE OF MONOSEX NILE TILAPIA (*OREOCHROMIS NILOTICUS*) IN CAGES USING LOW COST, LOCALLY PRODUCED SUPPLEMENTAL FEEDS AND TRAINING FISH FARMERS ON BEST MANAGEMENT PRACTICES IN KENYA

Sustainable Feed Technology and Nutrient Input Systems /SFT/13SFT06AU

Collaborating Institutions and Lead Investigators

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Objectives

1. Develop low-cost, improved quality feeds utilizing rice bran and freshwater shrimps (*Caridina nilotica*) as fishmeal replacement.
2. Evaluate the growth performance of monosex Nile tilapia under three different feeding regimes in cages.
3. Transfer technologies on management of monosex tilapia in cages through training farmers and extension officers.
4. Compare work conducted in this investigation on the use of low-cost supplemental feeds with the accomplishments of 20 years of CRSP-related work in the area.

Significance

Expensive commercial feeds represent the most significant operating cost for intensive tilapia aquaculture in Kenya. Finding lower cost ingredients capable of supplying adequate protein and nutrition is a major goal of fish nutrition research. In many developing countries, fishmeal, the most common protein source in prepared fish feeds, is expensive. Using alternative sources of protein would help reduce the costs of feed inputs and increase income for small-scale fish farmers.

Certain composted organic materials are a potential source of protein for aquaculture feeds. Sumagaysay (1991) demonstrated that composted rice straw could be used in milkfish diets and Ray (1992) reports that composted *Salvinia cuculata*, an aquatic weed, could be used in Indian carp diets. In Kenya, agricultural by-products could be used as cheap, high-nutrient components of locally produced fish feeds. Rice-bran is widely available and could be combined with a low-value fish species, such as freshwater shrimp (*Cardina nilotica*), to produce the nutritional base for locally sourced, sustainable fish feeds.

Another obstacle to income generation for small-scale tilapia farmers is prolific breeding that occurs due to precocious maturity when males and females are reared concomitantly. Ponds stocked with both sexes can result in the production of small fish of little market value. The technology needed to breed monosex, all male, fry is not available, or is too complicated for the average fish farmer. Using monosex tilapia will improve productivity by eliminating the incidence of precocious maturity and allow fish to grow more rapidly to the desired market size.

Another improvement that can be made to increase income generation among small-scale fish farmers is implementing cage culture systems. These systems areknown to require a larger capital investment, but returns are much higher than static pond culture systems. However, low cost quality feeds are needed in ponds and cages when farmers wish to produce more fish than can be supported from fertilized (extensive) systems. This is largely because fish stocked in cages do not have access to the entire water body for feeding, and require more intensive inputs to achieve adequate nutrition. Improvements to the feed manufacturing ability of cluster farmers will facilitate development of cage culture systems in the country, which will in turn increase productivity.

Many small farmers will be encouraged to build and utilize cages to increase their household income and nutrition. After construction of the cage, cost of feed becomes the major input cost for fish production. Complete formulation diets are available but are quite expensive. Introduction of supplemental feeds using low-cost, locally available protein sources would remove the constraint of access to commercial feeds and develop markets for freshwater shrimps and agriculture by-products, such as rice bran. Introducing pelleting technology will greatly improve feed stability and quality.

Experimental Design

The null hypothesis to be tested in this experiment is as follows:
The growth performance of monosex Nile tilapia using low cost improved feed is not different from the growth performance using standard commercial feed.

We will develop and test low-cost feeds utilizing locally available ingredients and pelleting technology in grow-out trials of monosex tilapia in cages. Diet formulations utilizing freshwater shrimps and rice bran will be prepared using motor-driven pelleting equipment. Feed will be prepared on commercial pelleting equipment fabricated and distributed to cluster farmers. The experimental feeds will be tested for stability in water and proximate analysis at the University of Nairobi. Feeding trials will be conducted with monosex tilapia reared in cages at the farm. Initial stocking rates for the cage trials will be 50 fingerlings per m^3, with an expected harvest size of 500g each over a period of six to eight months depending on temperature regimes.

During the grow-out trials, twenty fish per replicate will be sampled monthly. Growth, survival, and cost of production will be determined for fish on experimental diets and the control ponds. Water quality parameters including dissolved oxygen, pH, nitrogen (ammonia, nitrates and nitrites) and turbidity will be examined on a weekly basis. The cage trials will receive the pelleted diet under three formulated regimes. Four replicates of cages measuring $2m^3$ will be used for each treatment and the control. They will be suspended in a pond whose water runs through so as to maintain high oxygen levels. The null hypothesis that the fish will all have equal growth will be tested with ANOVA at 5% confidence limit. The tests will be performed with the assistance of Minitab Version 14 or a comparable software package.

Quantified Anticipated Benefits

The research described below addresses several constraints mentioned in the AquaFish Innovation Lab proposal. One research priority is in the area of environmental impacts and effluent control. Other experiments attempt to further improve biological and technological knowledge of pond systems, specifically best management practices and the use of technologies in production systems.

Supplementary activities concentrate on human capacity development, especially extension of aquaculture information to local farmers in the country. Increased tilapia and other warm water fish production from pond and cage systems would be applicable to most tropical and sub-tropical regions. Using low cost ingredients will allow small producers to rear more fish in a limited area without investing money in expensive nutritionally complete diets. Pelleting technology will provide a pellet that will have

greater stability in the water and allow the fish to get the full benefit of the feed ingredients. Pelleting also reduces the production of fines that are not available to the fish and can degrade water quality.

Furthermore, the research has the potential to improve gender integration in aquaculture by involving women in the sourcing, processing, and manufacturing of pelleted feeds. This part of the production chain would be transferred from commercial feed factories to the harvesters and their associates, creating a great opportunity to expand women's involvement in the aquaculture industry.

Identification of Beneficiaries

Tilapia producers in the Kenya would be the most immediate beneficiaries of the development of low cost feeds. Consumers of fish should be beneficiaries of larger volumes and lower cost farmed fish. Suppliers of freshwater shrimps and rice bran would benefit as new markets develop for their products.

Impact Indicators and Targets

- Twenty small-scale farmers adopting use of monosex production practices
- Twenty fish farmers adopting cage culture system technology
- Fifty fish farmers trained in use of low cost feeds and monosex culture
- Five extension officers trained in use of technologies and best practices

Collaborative Arrangements

Earthen ponds, round tanks, and a wet lab are available for this study. Graduate students will construct cages from locally sourced materials. Trained technicians and extension specialists will be available to support and extend the research. Mwea Aquafish Farm will provide the pelleting equipment, lab facilities for water and feed analyses, and stocks of monosex tilapia that will be used for production trials in cages.

Schedule

November 2013:	Select graduate students, obtain pelleting machine and make cages
December 2013:	Select spawners for production of fry (HC PI will leverage cost)
February–March 2014:	Collect tilapia fry/fingerlings and begin hormone treatment
April- 2014:	Annual meeting to be determined
May- October 2014	Feeding and sampling
October 2014:	Training cluster fish farmers and extension officers on BMPs
November 2014:	Harvest ponds and cages, collect data
December 2014:	Second farmers training
February 2015:	Annual meeting to be determined
March 2015:	Analyze data and prepare reports
June 2015:	Submit Final Reports and journal articles

Deliverables

Item	**Mechanism (e.g. podcast reports factsheets etc.).**
Low-cost feeds	Manuscript describing uses and applications
Training on BMPs	Training report
Results of trials	Journal article