ON FARM VERIFICATION OF TILAPIA-CATFISH PREDATION CULTURE

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ABSTRACT

This study was conducted to compare the effects of all-male culture and tilapia-catfish polyculture systems on the growth performance of Nile tilapia under farm conditions. The study involved six farmers from two villages (i.e. Changa and Kibwaya) in the Morogoro rural district, Tanzania. The farmers were divided into three groups. The first group stocked only male tilapia in their ponds (treatment 1). The second group stocked mixed sex tilapia and African catfish (treatment 2) and the third group stocked tilapia of mixed sex (male and female) (treatment 3). The tilapias were stocked at a density of 3 fingerlings per m^2 in all the treatments. For treatment 2, the ratio of catfish: tilapia was 1:10. The catfish were introduced into the ponds 45 days after stocking the tilapia fingerlings. Each pond was fertilized with farm yard manure. The experimental period lasted for 120 days. The fish were supplemented with a concentrate diet comprised of maize bran (79%), soybean (20%) and mineral premix (1%). The quantity of feed offered per day was 5% of tilapia biomass. The pH values ranged from 7.1 ± 0.18 to 7.2 ± 0.13 while dissolved oxygen ranged from 7.4 ± 0.18 to 7.7 ± 0.21. Water temperature ranged from 27.2 ± 0.11 to 28.0 ± 0.01^{o}C during the experimental period. The fish on treatment 1 showed≤0.0001)significantlyhigherweight(P gain (65.95 ± 1.19 g) compared to those on treatment 2 (55.43 ± 1.81 g) and treatment 3 (37.71 ± 3.03 g). Likewise, the fish on treatment≤0.0001) higher1hadsignificantlygrowthrate (P(0.55 ± 0.01 g/d) than those

on treatment 2 (0.47 ± 0.02 g/d) and treatment 3 (0.31 ± 0.02 g/d). The highest body length was observed on fish under treatment 1 (12.04 ± 0.09 cm), followed by those on treatment 2 (11.23 ± 0.10 cm) and treatment 3 (9.61 ± 0.2 cm). It is concluded that the tilapias under the all-male culture system had higher growth rate and gained more weight than the tilapias which were grown under mixed sex and polyculture with catfish. Moreover, the growth performance of tilapia under tilapia–catfish polyculture was better than that of tilapias under mixed sex culture.

INTRODUCTION

Aquaculture in Tanzania is done using mostly Nile tilapia (*Oreochromis niloticus*) (URT, 1997). The

Nile tilapia is given first priority due to their better characteristics that include fast growth, short food chain, efficient food conversion, high fecundity (which provides opportunity for distribution of fingerlings from farmer to farmer), tolerance to a wide range of environmental parameters, and good product quality (Hussain *et al*., 2000; Neves *et al*., 2008). Most tilapia species can grow in brackish water and some are adapted to sea water and most often are grown in ponds, cages and rice fields. However, tilapia farming is dominated by freshwater fish farming in which small-scale farmers practice both extensive and semi-intensive fish farming. Usually small fish ponds of an average size of 150 m^2 are integrated with other agricultural activities such as gardening, rabbit and poultry production on small pieces of land.

A general problem associated with the culture of tilapia is their prolificacy, which often results in large populations of small-sized (stunted) fish which are of low value to consumers (Moses, 1983). This problem of overcrowding in the production setting has resulted in various techniques being developed to control unwanted reproduction in ponds and produce tilapia of large market size. The techniques include stock manipulation (high density stocking), polyculture of tilapia with predatory fish, monosex culture , sex reversal by androgenic hormones, cage culture, tank culture, sterilization (through the use of irradiation, chemosterilants and other reproduction inhibitors) and intermittent/selective harvesting (Mair & Little, 1991). Among these methods, the use of local predatory fish species to control unwanted/undesirable tilapia recruitment in ponds seems to be more convenient in rural areas at the small-scale farmers' management level. One of the predatory fish used to control pond overpopulation is the African catfish. Stocking African catfish with mixed sex tilapia populations controls recruitment and allows the original stock to attain a larger market size (De Graaf *et al*., 1996). Predators are usually stocked at a small size to prevent them from eating the original stock. Predators may be stocked when tilapia begin breeding. The number of predators required to control tilapia recruitment in culture ponds depends primarily on the maximum attainable size of the predator species, the ability of the predator to reproduce, and the number of mature female tilapia (Fagbenro and Syndenham, 1990).

Another method for resolving the problem of uncontrolled reproduction in ponds of small-scale fish farmers is the culture of an all-male population. Since the males have higher growth rates than the females, production of larger fish and higher yields are possible when all-male stocks are grown. All-male tilapia populations can be produced by hand sexing of the fingerlings, crossing of some tilapia species and hormonal sex reversal. Hand sexing of the fingerlings is the only feasible method that can be applied under farmers' condition in Tanzania.

Despite the potential benefits of tilapia-catfish polyculture and all-male culture, not much has been done in Tanzania to explore the use of these technologies as a means of controlling tilapia overpopulation in ponds and hence, the need for this study. The technologies have not progressed beyond their use in experimental studies and they have not been adopted by the small-scale farmers in rural areas. This study was carried out to assess the advantages of tilapia-catfish culture and all-male culture of Nile tilapia under small-scale farmers' condition. It was anticipated that the findings from this study will make the small-scale fish farmers in rural areas adopt the technologies and thus solve the problem of producing stunted tilapias in their ponds and fetch higher prices by selling large sized tilapia and perhaps encourage more farmers to get into fish farming.

The objectives of the study were:

5. To validate the research-extension based recommendations on Nile tilapia-African catfish predation culture by comparing growth performances under farmers' conditions.
6. To compare economic returns between monoculture of tilapia and tilapia-catfish polyculture.
7. To train small-scale fish farmers on manual separation of sexes of Nile tilapia at the fingerling stage.
8. Support a graduate student at the M.SC level.

Materials and Methods Location of study area

The study was carried out at Mkuyuni Division, Morogoro rural district, in two villages- Changa and Kibwaya. Mkuyuni is located on the eastern slopes of the Uluguru Mountains, about 50 kilometers south of Morogoro municipal town at latitude $6^0$48'S and longitude 37^0 42'E. Temperature ranges from 15^0C to 40^0C with a mean of 25^OC. The area has a tropical climate.

EXPERIMENTAL PROCEDURE

A total of six farmers from the two villages were selected to participate in this experiment. The selection of the farmers was based on their willingness to participate in the study and construction of earthen ponds. Each farmer constructed one earthen pond. The sizes of the ponds ranged from 84 to 285 m^2 at the surface area and depth of 1 m. The farmers were grouped into three groups of two farmers each. The two ponds of the first group were stocked with male tilapia only (all-male culture) (treatment 1). The ponds of the second group were stocked with mixed sex tilapia and African catfish (Tilapia-catfish polyculture) (treatment 2). The ponds of the third group were stocked with tilapia fingerlings of mixed sex (male and female tilapia culture (treatment 3). The tilapias were stocked at a density of 3 fingerlings per m^2 in all the 3 treatments. For treatment 2, the ratio of catfish: tilapia was 1:10. The catfish were introduced into the ponds 45 days after stocking the ponds with tilapia fingerlings. The tilapia fingerlings were manually sexed to obtain all male fingerlings for stocking in treatment 1.

Prior to commencement of the experiment, all ponds were drained, sun-dried, and refilled up to about one meter with water from the peripheral canal. Each pond was fertilized with farm yard manure. The experiment was carried out for 120 days between July and November 2009. During the experimental period, the fish were supplemented with a concentrate diet comprised of maize bran (79%), soybean (20%) and mineral premix (1%). The diet contained 20% crude proteins and the quantity of feed offered per day was 5% of tilapia biomass .

Body weights of a random sample of 20 tilapias from each pond were measured by using an electronic balance at the start of the experiment and then at day 30, 60, 90 and 120 of the experiment and growth rates were computed. Fork lengths of 10 fish randomly selected from each pond were measured using a measuring board at day 30, 60, 90 and 120 of the experiment. In addition, temperature was determined using a digital thermometer, dissolved oxygen (DO) concentration was determined using a digital DO meter (Jennway2001) and pH was determined using a digital pH meter (Portmass 911) at monthly intervals during the experimental period.

Data analysis

The data collected were analyzed using the General Linear Models procedure of the Statistical Analysis System (SAS, 1998). The treatments (T1, T2 and T3) were used as the fixed effect and the initial body weight and body length were used as the covariates. The dependent variables were body

weight gain, growth rate and body length.

RESULTS

Water quality parameters

The analysis for water quality parameters indicated that the values for pH, DO and temperature did not differ significantly ($P > 0.05$) among the treatments. The average (± s.e.) pH values ranged from 7.1 ± 0.18 to 7.2 ± 0.13. The highest DO value (7.7 ± 0.21) was observed in July 2009 while the lowest value (7.4 ± 0.18) was observed in October 2009. The temperature ranged from 27.2 ± 0.11^{o}C in July to 28.0 ± 0.01^{o}C in November 2009.

Growth Performance

Average (± s.e.) initial body weights of tilapia fingerlings were 1.55 ± 0.07, 0.83 ± 0.21 and 1.04 ± 0.32 g for the fish on treatment 1 (all-male tilapia culture), treatment 2(polyculture of mixed sex tilapia and catfish) and treatment 3 (male and female tilapia culture), respectively. The final weights at 120 days of age were 67.50 ± 1.19 for treatment 1, 56.25 ± 1.61 for treatment 2 and 38.75 ± 3.31 g for treatment 3. The treatments≤0.0001)effectshadsignificantonweight(Pgain and growth rate of the fish. The fish on treatment 1 had the highest weight gain (65.95 ± 1.19 g), followed by those on treatment 2 (55.43 ± 1.81 g) and lastly by fish on treatment 3 (37.71 ± 3.03 g). Likewise, the fish on treatment 1 had significantly higher growth rate (0.55 ± 0.01 g/d) compared to those on the other treatments. Moreover, fish on treatment 2 had significantly higher growth rate (0.47 ± 0.02 g/d) than those on treatment 3 (0.31 ± 0.02 g/d).

The tilapia fingerlings had initial body length of 3.51 ± 0.11 (treatment 1), 3.34 ± 0.12 (treatment 2) and 3.41 ± 0.011 cm (treatment 3). The final body length values differed significantly≤0.001)among(P treatments. The highest body length value was observed on fish under treatment 1 (12.04 ± 0.09 cm), followed by those on treatment 2 (11.23 ± 0.10 cm), and fish on treatment 3 had the lowest body length (9.61 ± 0.2 cm).

Generally, the all-male tilapia culture resulted in tilapias that showed higher growth rate and gained more weight than the tilapia which were grown under mixed sex and polyculture with catfish. However, the growth performance of tilapia under tilapia – catfish polyculture was relatively better than that of tilapias under mixed sex culture.

Training of small-scale fish farmers

A farmers' training workshop was conducted for two days and 15 farmers (9 men and 6 women) attended the workshop. The farmers who attended the workshop included the six farmers participating in the project and nine other farmers who have shown interest in participating in the project. The farmers were from three villages (i.e. Changa - 6 farmers, Kibwaya - 4 farmers, and Manza - 5 farmers in Morogoro Rural district. The training workshop was conducted on 25th and 26th November 2009 at the Department of Animal Science and Production, Sokoine University of Agriculture. Also the farmers visited Kingolwira Fishery Centre in Morogoro and had hands-on learning experience on manual sexing of Nile tilapia and African catfish. The farmers were given training on the following topics: (1) Importance and potential of fish farming, (2) Pond preparation and construction, (3) Assessment of pond structures, (4) Fingerling transportation and introduction in ponds, (5) General fish management practices and feeding of tilapia, (6) Practical feed ration formulation, (7) Polyculture of tilapia and catfish, (8) Practical manual sexing of tilapia and catfish,

and (9) Artificial propagation of tilapia.

The group also discussed how fish farming could provide an alternative source of protein and income to households in the rural areas. The discussions were highly participatory including aspects such as problem definition and problem ranking. Possible solutions to various constraints were discussed.

QUANTIFIED BENEFITS

- Fish farmers are now aware of the importance and benefits of monosex (all male) Nile tilapia culture. The all-male culture of tilapia resulted in significantly improved growth performance and resulted in larger fish and higher yields of tilapia than the yields obtained from growing tilapia mixed with African catfish.

- Fish farmers now know that growing tilapia of mixed sex together with African catfish in the same pond controls excessive reproduction and produces tilapia of relatively larger size compared to only mixed sex tilapia in the same pond.

- 15 small-scale farmers acquired the expertise of hand sexing of tilapia fingerlings through a training workshop.

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