Staff at the Ayutthaya Freshwater Fisheries Station in Thailand sample tilapia as other CRSP participants watch on.

Southeast Asia

Increasing the carrying capacity of ponds or harvest size of tilapia requires more intensive management practices, which largely involves supplemental feeding. The addition of supplemental feeds increases growth rates of fish stocked at higher densities; however, feeding and density increases are constrained by increased oxygen demand, build up of metabolites, or other factors which result in poor water quality. PD/A CRSP researchers from the Asian Institute of Technology (AIT) and the University of Michigan designed an experiment to test the upper limits of tilapia production utilizing supplemental feeds. Stocking densities of 3, 6, and 9 fish per m^2 were tested. While the most rapid growth and the highest survival occurred at a stocking density of 3 fish per m^2, and even though water quality remained relatively high with intensive feeding at the highest stocking density, the optimal feeding system appeared to be at a stocking density of 6 fish per m^2, particularly if the fish had been allowed to reach 500 g in size. This regime resulted in a profit of $150 per pond.

In terrestrial agriculture, analyses of extracts from soil samples are commonly used to estimate nutrient availability because the amounts of nutrients in these extracts are correlated with concentrations of nutrients in soil solution that are available to plants. It may be possible to perform similar analyses regarding the availability of nutrients in aquaculture ponds from bottom soil properties. Auburn University researchers conducted a study using laboratory soil-water microcosms under controlled conditions to determine if aqueous concentrations of substances could be predicted from soil characteristics. Data suggested that soil analyses can indicate the concentrations of water quality variables that will occur in ponds built on particular soils. Additionally, it was found that soil extractions in the dilute-acid solution provided better estimates of nutrient concentration than neutral, ammonium acetate extraction. However, further research that compares water quality in ponds with bottom soils of different physical and chemical characteristics is needed. Studies within this area could: lead to the development of more precise methods for estimating water quality and productivity from soil characteristics; allow for better use of existing soil survey data in planning aquaculture projects; and be used as a basis for recommending nutrient management programs for ponds in a given area.

Program researchers at AIT designed an experiment to develop an integrated rotation culture system for tilapia. The purpose of the experiment was to determine the effects of stocking densities of small tilapia in open ponds on the growth performance of both caged and open-pond tilapia. The growth performance of both large and small tilapia from the integrated culture system was compared with growth performance of tilapia from a mixed-pond culture system. All measures of growth performance were significantly better in the integrated culture system than the mixed-pond culture system at the same stocking density. The experiment successfully demonstrated the practicality of the cage-tilapia-cum-pond-tilapia integrated rotation system based on the intensive culture of adult Nile tilapia in cages and the semi-intensive culture of small Nile tilapia in the open water of earthen ponds. One of the major advantages of the integrated culture system is the option of controlling unwanted recruitment. Furthermore, less working capital is needed for the integrated culture system than for other intensive culture systems, since tilapia are harvested and marketed every three months. More frequent marketing may allow producers to receive better prices. The integrated culture system may be appropriate for small-scale farmers in countries such as Thailand, where large tilapia (> 500 g) receive a much higher market price than those typically harvested in fertilized ponds, which weigh between 250 and 300 g.

PD/A CRSP researchers from AIT and the University of Michigan assessed the effects of carp-tilapia polyculture on water quality and fish yield in deep, rain-fed ponds. Water temperatures and dissolved oxygen (DO) concentrations of surface water and water at the bottom of ponds for monthly data were not significantly different among treatments. DO values were most variable, and mean total Kjeldhal nitrogen and chlorophyll-*a* concentrations in all treatments showed an increase toward the end of the culture periods. Experimental results did not reveal any differences between net fish yields from the Nile tilapia monoculture and the polyculture of Nile tilapia with common carp at different densities. Common carp lost weight

during the experimental period in polycultured ponds, which may have been due to the undesirable feeding habitat available to the carp in deep ponds. The accumulation of organic matter in the bottom of deep ponds can lead to an oxygen deficit condition and the production of reduced substances, such as nitrite, ammonia, hydrogen sulfide, and methane, which are toxic to benthic organisms.

Carp/tilapia polyculture may be more difficult in ponds constructed on acid sulfate soils because carp tend to stir sediment as part of their feeding activities. This may result in reduced alkalinity as well as in the suspension of aluminum or iron, which in turn could affect phosphorus availability. Researchers from the University of Hawaii and AIT therefore conducted an experiment to determine the effect of carp/tilapia polyculture on fish production, nutrient dynamics, turbidity, and primary productivity. Tilapia growth was slow and uniform across treatments. Carp growth was extremely sensitive and inversely related to stocking density. There were only slight indications of treatment-related differences in water quality, except for measures of turbidity. Biomass rather than individual fish size increased suspended solids. Chlorophyll-*a* levels were not high; however, they were sufficient to improve tilapia growth.

Data from the CRSP Central Database were analyzed by researchers from the University of Hawaii to determine the relationship between primary productivity and fish production. Primary productivity/fish yield relationships were compared with the results of PONDCLASS trials in Thailand and the Philippines. Most ponds produced 2 to 8 mg/l DO during the daytime. Daytime DO production and fish yield were related with high statistical significance.