Carp/Tilapia Polyculture on Acid-Sulfate Soils

Work Plan 7, Thailand Study 5

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Introduction

PD/A CRSP research in Thailand has concentrated on the dynamics of *Oreochromis niloticus* monocultures. Because *O. niloticus* is primarily a planktivore, the addition of the benthic detritivore *Cyprinus carpio* should lead to increased system productivity through the conversion of currently unutilized benthic matter into fish flesh. The inclusion of carp in the culture system may also increase the recycling rate of nutrients by resuspension of settled organic matter as a result of the stirring activities of the carp (Hopkins and Cruz, 1982). Costa-Pierce and Pullin (1989) suggested that bottom stirring can increase fish production in ponds. This stirring activity may also affect stratification, particularly in deep ponds. The preceding companion study examines carp/tilapia polycultures in deep ponds in Northeast Thailand (p. 157).

Although adding carp to a tilapia monoculture has the potential to increase yields, it may also have the potential to seriously decrease yields if the pond has acid-sulfate soils. Carp could suspend acidic soil into the water column, thereby leading to decreases in alkalinity and subsequent carbon limitation. Also, suspension of muds high in aluminum and iron could, under acidic conditions, lead to removal of phosphorus from the water column. Both carbon and phosphorus limitation could decrease yields. Therefore, a separate study to examine the effects of polyculture on water quality and yield in ponds with acid soils is necessary.

This study's objective was to determine the effects of adding common carp to tilapia culture on the following: fish production; nutrient dynamics including concentration of nitrogen, phosphorus, and carbon (alkalinity); turbidity; and primary productivity.

Materials and Methods

A five-month experiment was conducted in earthen ponds of 200 m^2 surface area at the Asian Institute of Technology. Fifteen ponds were allocated to five treatments with three replicates, in three blocks: block 1 was stocked with common carp juveniles of the smallest of three sizes, namely 11 to 14 g/fish; block 2 was stocked with carp of 23 to 30 g/fish; and block 3 with carp of 35 to 40 g/fish.

The treatments were:

- Tilapia only, stocked as fingerlings of 15-19 g/fish at 2 fish/m^2;
- Tilapia at 2 fish/m^2 plus common carp at 0.1 fish/m^2;
- Tilapia at 2 fish/m^2 plus common carp at 0.3 fish/m^2;
- Tilapia at 2 fish/m^2 plus common carp at 0.5 fish/m^2; and
- Tilapia at 2 fish/m^2 plus common carp at 0.7 fish/m^2.

The ponds were fertilized weekly with chicken manure at 250 kg dry matter/ha/wk and supplemented with urea and triple super phosphate (TSP) to attain rates of 28 kg N/ha/wk and 7 kg P/ha/wk. Water sampling and analysis were performed according to standard protocols, with detailed water sampling/analyses conducted every two weeks.

Results and Discussion

Only preliminary results are available for this experiment. It was noticed during the experiment that tilapia growth was slow and uniform across blocks and treatments. Investigation of the fingerling batch records showed that larger fish (> 25 g/fish) had been selected from the batch to stock a different experiment before this experiment was stocked. This may have left the naturally slower-growing fish, which are unable to grow at normal rates in the fertilized ponds and may have thus obscured treatment effects.

Carp growth was extremely sensitive and inversely related to stocking density, as shown in Figure 1. Reproduction of carp took place in most ponds; these fish were excluded from the growth analysis discussed here. Carp of initial (pond mean) weights 11 to 40 g/fish grew to pond means of 41 to 270 g/fish during five months. There was considerable "growth compensation" (tendency for carp in ponds within a treatment to become more uniform in size) in percentage terms, particularly in the two greatest densities, as would be expected with density-limiting growth.

Through the first half of the experiment, there was little indication of treatment-related differences in water quality except in measures of turbidity.

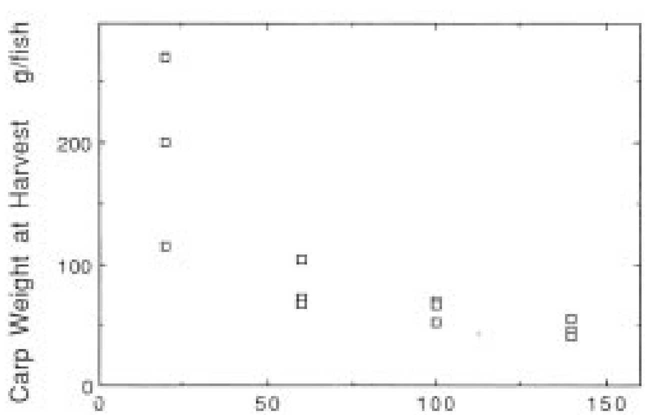

Figure 1. Final individual weight (pond means) of carp in ponds stocked at four different densities.

Secchi depth was slightly greater in ponds without carp; total suspended solids were markedly lower, with mid-point date values of 117 mg/l without carp and 175 to 201 mg/l with carp. Volatile solids did not differ significantly, implying that the difference in total suspended solids (TSS) is attributable to non-volatile or mineral solids (mud). Chlorophyll-*a*, representing food production in the pond ecosystems, did not differ significantly among treatments at the mid point.

Although chlorophyll-*a* levels were not particularly high (99-160 µg/l), they should have been sufficient to produce better growth of tilapia than was observed. Therefore, the batch-selection problem remains the most likely explanation for lack of treatment differences. The larger fish from this batch grew normally in ponds in an experiment in which they were fed.

The parameters chosen for this experiment were appropriate to produce treatment-related differences in suspended solids and to reveal the density dependence of carp growth. Suspended solids tended slightly upward with increased carp density and total biomass of a pond (not individual size) in this experiment, indicating that numbers or biomass were more important than individual size for this factor.

Acknowledgments

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