Effect of Chicken Manure Additions on Fish Production in Ponds in West Java, Indonesia

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ABSTRACT

Results of experiments in Cycle III of the Pond Dynamics/Aquaculture CRSP are reported here. Two experiments were conducted: one lasted l56 days and the other lasted l49 days. During both experiments four levels of dried chicken manure (12.5, 25, 50 and 100 $g/m^2/wk$) were added to 0.02 ha ponds. There were three ponds in each treatment. Results of the two experiments were similar. Yield of Nile tilapia *(Oreochromis niloticus)* at final harvest increased linearly with increasing fertilizer application from about 900 kg/ha in the lowest treatment to approximately 2300 kg/ha in the highest. Increased algal productivity and an apparent increase in detritus accompanied increasing fish yield. Analyses of nitrogen and phosphorus suggested that higher algal productivity and fish yields could be obtained by improving the fertilizer regime so that N and P. are available in these ponds in proportions required by pond microflora.

INTRODUCTION

During 1986-87, the third experimental cycle of the CRSP was completed at the Babakan Fisheries Station of Institut Pertanian Bogor in Indonesia.

The Bogor region of West Java is hot and hyperhumid with annual rainfall in the range of 3-6 m per year, Increasing with elevation on the surrounding mountain peaks. High rainfall combined with low evaporation rates causes severe leaching of ions from porous volcanic soils in the region. Since these soils have been in place for a long time, they yield few mineral nutrients to the surface waters that drain them. This has important implications for freshwater pond culture in the Bogor region and other wet-tropical regions like it. Nutrients necessary for pond production tend to be in short supply in water used to fill ponds. In practice, this condition is overcome by adding fertilizers or feed to ponds. For economic and biological efficiency, fertilizer applications should be based on the balance of mineral nutrients required by fish-food organisms whose growth they are intended to promote, namely algae, bacteria, and associated microfauna.

Phosphorus, nitrogen, and carbon are elements that most frequently limit production of pond organisms used as food by fish. For normal growth, algae require phosphorus, nitrogen and carbon in the atom ratio of 1:16:100. This converts to a weight ratio of 1:7:40. In fishponds where this ratio is not approximated in the process of fertilizer application, the element(s) in shortest supply should be exhausted by uptake and growth of algae, leaving a surplus of the other essential elements unused in the water. Inorganic carbon is in short supply in surface waters of the Babakan region; carbonate-bicarbonate alkalinity is approximately 20 mg/l.

Data from Cycle II showed that low levels of inorganic carbon limited productivity of algae and fish in ponds fertilized with 50 g dry wt/m^2/ wk of chicken manure or triple superphosphate + urea at P and N loading rates equivalent to chicken manure. Cycle III experiments were designed to assess the performance of chicken manure across a range of loadings from 12.5 to 100 g dry wt/m^2/ wk. The relationship between fish yield and efficient use of fertilizer nutrients was evaluated.

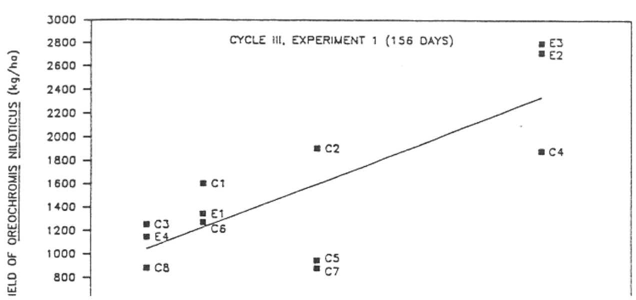
MATERIALS AND METHODS

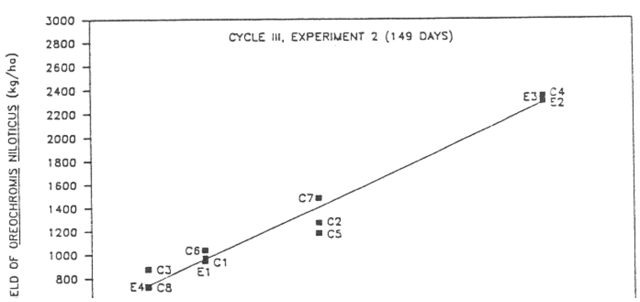
In this experimental cycle, four levels of dried chicken manure (12.5, 25, 50, and 100 g/ m^2/ wk) were added to 0.02 ha ponds at the Babakan Fisheries Research Station. There were three ponds in each of these four treatments. After liming, the ponds were filled and maintained at a depth of approximately 0.9 m by adding water diverted from an irrigation canal at the perimeter of the site. Two experiments were conducted, each with the same protocol. One experiment ran from April 9 to September 12, 1986, the other from October 14, 1986, to March 12, 1987. After ponds were filled with water, male *Oreochromis niloticus* (*Tilapia nilotica*) fingerlings were planted at a density of one fish per square meter of pond surface. Methods described by Egna et al. (1987) for water sampling and chemical analyses were used except in regard to primary productivity. Daily net primary productivity was obtained from inorganic carbon losses that occur between dawn and dusk from the carbonate-bicarbonate system in ponds (after Harvey 1955 and Park 1969).

RESULTS

O. niloticus stocking density for all ponds in Experiments 1 and 2 was 1 fish/m^2 (200 fingerlings/ pond). Mean total weight stocked in the four treatments of Experiment 1 ranged from 9.6 kg to 10.3 kg. The mean weight of individual fingerlings varied among treatments from 49.2 g to 55.0 g. For Experiment 2, mean total weight stocked in treatments ranged from 8.6 to 9.1 kg. Mean weight for individual fingerlings stocked varied among treatments from 43.2 g to 45.3 g.

Yields obtained by harvest at the end of grow-out periods are shown in Figure 1 in relation to chicken manure loading rates used. Yields tended to increase linearly with increased loading, reaching a maximum of 2300 kg/ha at 100 g dry wt chicken manure/m^2/wk. The data show that ponds at Babakan could be loaded each week with greater quantities of chicken manure before yield approached an asymptote. Maximum yield obtained in the experiments was high compared to that reported in the literature. Pownall (1975) reported average yields for farm ponds in West Java on the order of 1500 kg/ha/yr. with some reaching 3000kg/ha/yr. *Cyprinus carpio* accounted for most of this production. DeMaeseneer (1984) cites production of 2000 kg/ha/yr for tilapia in tropical subsistence ponds that are earnestly managed. With grow-out periods of the length used in these experiments two crops per year could be obtained at Babakan, yielding nearly 4600 kg/ha. This rate of production approaches that expected by Balarin (1984) as a maximum with tilapia in well managed ponds using feeds and fertilizers: namely, 5000 kg/ha/yr.





Water chemistry data collected from ponds in Experiments 1 and 2 showed similar trends. Data from Experiment 2 are used to describe results. Table 1 shows algal productivity associated with application rates of chicken manure used in the experiment. Net photosynthesis ranged from 0.82 to 1.86 g C/m^2/day. Gross photosynthesis (net carbon fixed by algae per day + carbon fixed to supply O_2 for community respiration per day) ranged from 1.72 to 3.06 g C/ m^2/day. Hepher (1962) reported mean net productivity in fertilized fish ponds In Israel at 2.89 g C/m^2/day, and gross productivity from 4 to 6 g C/m^2/day. Steeman Nielsen (1958) considered a rate near 8 g C/m^2/day the maximum for algal productivity. By