Nitrogen input, primary productivity and fish yield in fertilized freshwater ponds in Indonesia

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Abstract

Twelve 0.2-ha ponds in West Java were fertilized weekly with four levels of chicken manure (12.5, 25, 50, and 100 g dry weight/m^2 $week^{-1}$) during a 149-day growout experiment for Nile tilapia (*Oreochromis niloticus*) production. Laboratory leaching experiments for measuring dissolved inorganic nitrogen (DIN) release from chicken manure showed that nitrogen was released as ammonia-N, which was rapidly lost from the manure and leveled off at about 6 mg NH_4---N/g dry weight chicken manure after 4–5 days. Allochthonous DIN input from both chicken manure fertilization and almost daily source-water additions ranged from 0.055 to 0.142 g N/m^2 day^{-1}. Source water contributed more nitrogen than manure in all but the highest fertilization treatment.

Pond averages of net primary productivity (NP) ranged from 0.54 to 2.00 g C/m^2 day^{-1}, while gross fish yield at harvest ranged from 4.9 to 15.7 kg fresh weight/ha day^{-1}. Net fish yield (NFY) was linearly correlated to both the dry weight sum of NP and chicken manure fertilization (r^2=0.97) and allochthonous DIN input (r^2=0.96). Results suggest that Nile tilapia obtained organic carbon from both primary productivity and manure-derived detritus.

DIN availability limited algal productivity at a chicken manure fertilization rate of 100 g dry weight/m^2 $week^{-1}$ when microbial decomposition of manure supplied sufficient CO_2. Incorporation of allochthonous DIN input into NFY increased significantly from 15.0% at the three lower fertilization rates to 25.4% at the highest loading rate. Using organic fertilizers proportionally rich in phosphorus and carbon relative to nitrogen may maintain this element's limitation of algal productivity. Efficient utilization of DIN input also may minimize total and un-ionized ammonia concentrations. In the absence of deleterious ammonia effects on survival and growth, fish yields can be readily predicted from measurements of nitrogen inputs.

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