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SUSTAINABLE AQUACULTURE FOR A SECURE FUTURE

Title: Hybrid catfish (*Clarias macrocephalus* × *C. gariepinus*) and Nile tilapia (*Oreochromis niloticus*) culture in an integrated pen-cum-pond system: growth performance and nutrient budgets

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Abstract: Two experiments were conducted in 200-m^2 earthen ponds at Asian Institute of Technology, Thailand, for 87 days to test the feasibility of an integrated pen-cum-pond system, which utilizes wastes from intensive culture of hybrid catfish (*Clarias macrocephalus* × *C. gariepinus*) as nutrients for semi-intensive culture of Nile tilapia (*Oreochromis niloticus*). This integrated pen-cum-pond system enhances nutrient utilization efficiency, minimizes environmental impacts of pond effluents, and gains extra fish production at low cost. Experiment 1 was designed to compare the integrated pen-cum-pond systems with natural and artificial water circulation. Six randomly selected 200-m^2 ponds were partitioned by 1.0-cm mesh plastic net into two compartments: 1/3 of pond area (67 m^2) for hybrid catfish and 2/3 (133 m^2) for Nile tilapia. In experiment 2, one additional pond was partitioned by 1.0-cm mesh plastic net into three equal compartments with 67 m^2 each. The mesh was not cleaned and thus partitions serve as three replicates for hybrid catfish culture alone (non-integrated system). Experiment 2 was designed to compare growth performance of hybrid catfish and effluent quality from intensive culture of hybrid catfish among the non-integrated system with hybrid catfish alone (non-integrated treatment) and the integrated pen-cum-pond systems (natural and artificial water circulation treatments) in the 67-m^2 compartments. The nutrient budgets were also compared among the three culture systems. Sex-reversed all-male Nile tilapia were stocked at 2 fish/m^2, and hybrid catfish at 25 fish/m^2. Hybrid catfish were fed floating

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pelleted feed twice daily at rates of 3–10% body weight per day. During the first month, tilapia compartments were fertilized weekly using urea and triple superphosphate (TSP) at rates of 28 kg N and 7 kg P/ha/week. In the artificial water circulation treatment, the water in the catfish compartment was continuously circulated by a submersed pump to the tilapia compartment at a rate of one exchange per week, starting the second month.

There were no significant differences in growth performance of hybrid catfish among all treatments ($P>0.05$). Extrapolated net tilapia yields obtained by using hybrid catfish wastes in this study were comparable to those achieved in organically and inorganically fertilized tilapia ponds. The results indicated that neither natural nor artificial water circulation between catfish and tilapia compartments improved the growth of hybrid catfish. Nile tilapia growth was not significantly different between the natural and artificial water circulation treatments ($P>0.05$). However, the artificial water circulation caused mass mortality of Nile tilapia due to heavy loading of wastes. Nutrient budgets showed that total nitrogen (TN) and total phosphorus (TP) levels in pond effluents in the natural and artificial water circulation treatments were significantly lower than those in the non-integrated treatment ($P<0.05$). Nile tilapia recovered 3.30% and 2.12% of TN, and 1.29% and 0.84% of TP from feed wastes and fertilizer inputs in natural and artificial water circulation treatments, respectively. Concentrations of TKN, TP and SRP were significantly lower in the natural and artificial water circulation treatments than in the non-integrated treatment ($P<0.05$). This study demonstrates that the integrated pen-cum-pond system is feasible, indicates that Nile tilapia can effectively recover nutrients contained in wastewater of intensive catfish culture, and suggests that natural water circulation between catfish and tilapia compartments can reduce nutrient contents in pond effluents and is cost-effective.

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