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High stocking densities reduce Oreochromis niloticus yield: model building to aid the optimisation of production

Small-scale fish farming in tropical Africa is mainly based on pond culture of Nile tilapia Oreochromis niloticus with supplementary organic fertilisation. Until recently, the ‘high’ stocking densities practised (2 fish·m–2) led to stunted populations and very low yields. Since 1996, rural fish farming developed significantly in Côte d’Ivoire. Only a dramatic decrease in stocking densities allowed fish farmers to produce marketable-sized tilapia with reasonable yield in extensive culture. Density control is achieved through tilapia monosex male culture and stocking the predator Hemichromis fasciatus. Further development of low-input tilapia farming requires improvement of production results. A growth model based on maximal growth and ingestion, maintenance needs and efficiency of food for growth was developed to explain and help optimise production results. The model was validated with farm and experimental data and demonstrated that, for a given rearing period (from 30–50 g fingerling, to market-size), yield increased with density, but then decreased beyond an optimal density. When market-weight target is set, the same variation of yield according to stocking density is observed. Densities of 2 to 3 fish·m–2 markedly reduce tilapia yield in extensive culture. Moreover, increasing market weight from 150 to 450 g·fish–1 will only induce a limited decrease in maximal yield (around 20 %) if the density is lowered and the rearing period lengthened. This decrease is more than compensated by the higher price of large tilapia. Using rearing cycle data, the model can predict the results of alternate combinations of stocking density and duration of rearing period under the same pond management. Thus, production results can be optimised given the objectives and constraints of each fish farmer. This model is a valuable tool to develop extensive tilapia farming in tropical areas, and raises questions for researchers.

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