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RESEARCH REPORTS

SUSTAINABLE AQUACULTURE FOR A SECURE FUTURE

Title: Bio-energetic modeling of growth and waste production of Nile tilapia (*Oreochromis niloticus* L.) in recirculation systems

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Abstract: A bio-energetic fish growth simulation (FGS) model was developed for *Clarias gariepinus* and subsequently adjusted for the culture of *Oreochromis niloticus*, *Oncorhynchus mykiss* and *Colossoma macropomum*. The FGS model was extended with a fish waste module (FWM) to calculate the total waste production due to feeding by tilapias grown in indoor recirculation systems. Wastes calculated included the amount of uneaten feed, feces and NH_4^+ production. The amounts of wastes produced were expressed as g nitrogen (N). The model was calibrated and validated using 3 independent data sets, together comprising 175 aquarium experiments, monitoring growth in all cases and changes in proximate body composition of *O. niloticus* between stocking and harvesting in 51 cases. Fishes were grown in the individual weight range of 1 – 290 g using 32-54 % protein diets and feeding levels between 5 and 35 g $kg^{-0.8}$ d^{-1}. The principal read-out parameters for calibration and validation of the model were final weight and final body fat level. Because waste production is the

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result of the same metabolic processes that lead to protein and fat deposition, it was assumed that waste production was simulated well when protein and fat deposition are. The calibrated model was used to review the effect of feeding level and dietary protein level on N-waste production per kg tilapia produced. Finally, tilapias were grown in 2 different types of recirculation systems and stagnant water ponds, quantifying N-inputs and the amount of N-wastes recovered from each system. The latter was defined as the sum of N-waste discharged (sludge and sludge water drained) and within system accumulation of N-wastes (organic and inorganic nutrients) during culture. After model calibration, the agreement between simulated and observed final weight and body fat level for all data sets was visualized. In recirculation systems different types of N-wastes were estimated well by the model. Care must be taken when applying the model to pond systems. More insight is needed on feeding ecology of tilapias in these systems.

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