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# Nitrogen budget under different nitrogen inputs in integrated rice-fish culture in Bangladesh

Diploma Thesis

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# 6. Conclusion

It was shown that the presence of fish in rice fields has the potential to improve the N availability for rice. Providing supplementary feed has the advantage that excreted feed nutrients are absorbed by the rice plants. Both forms of N input, fertilizer and feed, have advantages regarding the output of a rice-fish system. Highest rice yields were obtained in the fertilized treatments and fish yield rapidly increased with the supply of feed. The results suggest that yields and also input efficiency might be maximized with a combination of reduced mineral fertilization and feed. The combination of fertilizer and feed might results into a complex production system, which requires additional knowledge and education of a rice-fish farmer.

Different types of N input in rice-fish culture affect the water quality of the floodwater. This can influence fish production in rice fields. In particular, low DO concentrations arise in connection with supplementary feeding and can limit fish production in rice fields.

Further research is recommended to optimise the N input efficiency of a rice-fish system. This could possibly be achieved by a combination of fertilizer and fish feed, the first to enhance rice growth and the latter to stimulate fish growth.

# 7. Summary

Rice-fish culture is an integrated agricultural system, in which scarce resources like land, water and nutrients are used in a complementary way. Management of N in rice-fish culture is of great significance in order to exploit these synergies between rice and fish and to avoid environmental pollution. However, detailed and systematic studies on N cycling in rice-fish systems are rare.

In order to evaluate the efficiency of fertilizer and feed as N inputs a nitrogen budget was established. The yield of rice and fish was determined and additional water quality parameters were examined. An experiment was carried out at the Bangladesh Agricultural University using the fish species common carp, *Cyprinus carpio* L. and Nile tilapia, *Oreochromis niloticus* (L.). The different N input regimes for rice-fish treatments were 1. regular urea fertilization (220 kg $ha^{-1}$) (RF), 2. supplementary feeding at 2 x maintenance level (RFL) and 3. supplementary feeding at 4 x maintenance initially and reduced feeding at 2 x maintenance towards the end of the experiment (RFH). Rice only with regular urea fertilization was added as a control (*R*).

Fish yields were the highest in the high feeding level (935 kg $ha^{-1}$), followed by the low feeding level (776 kg $ha^{-1}$) and lowest yields were obtained in treatment with no supplementary feed (515 kg $ha^{-1}$). Highest rice yields were found in the rice-fish treatment with urea fertilization (4.2 t $ha^{-1}$), followed by the control (3.8 t $ha^{-1}$). The treatments with supplementary feed showed lower rice yields ( 3.4 t $ha^{-1}$ for the low feeding level and 3.6 t $ha^{-1}$ for high feeding level).

The presence of fish significantly ($p<0.05$) decreased afternoon dissolved oxygen concentrations and afternoon pH values. Supplementary feeding lead to a significant ($p<0.05$) decrease of dissolved oxygen concentration. Chlorophyll-a and phosphorous showed significantly ($p<0.5$) higher levels in the rice-fish treatments compared to the control. The fertilized treatments had higher ammonia ($NH_4^+$) and nitrate ($NO_3^-$) levels than rice-fish treatments supplied with feed. Also the presence of fish enhanced the $NH_4^+$ and $NO_3^-$ concentrations in the floodwater. Significantly ($p<0.05$) higher amounts of particulate inorganic matter (PIOM) were detected in the rice-fish treatments than in the control.

Urea as N input (*Rice only, RF Urea*) resulted in negative N balances (N output – N input), whereas N input in form of feed (*RF Feed I, RF Feed II*) lead to positive N balances due to the low N input in the treatments supplied with feed. Higher N outputs of grain and straw was detected in *RF Urea*, compared to *Rice only*, differences in straw N output being statistically significant ($p<0.05$). The high feeding rate in treatment *RF Feed II* lead to higher N outputs of grain, straw and fish, compared to treatment *RF Feed I*. N outputs by fish and straw were significantly different ($p<0.05$). Higher yields of rice and fish and enhanced N contents of rice contributed to the higher N outputs, respectively.

In conclusion, the presence of fish increased N availability for the rice and by the supplementary feeding excreted feed nutrients for absorption of the rice plants are provided.