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## RESEARCH REPORTS

Sustainable Aquaculture for a Secure Future

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**Title:** Carbon Limitation in Fertilized Fish Ponds in Java

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**Abstract:** The backbone of Java consists of chain at some 25 major volcanic peaks. Among the peaks are ridges of uplifted limestone reefs. Groundwater and runoff from volcanic regions were mineral poor carbonate-bicarbonate alkalinity was on the order of  $20 \text{ mg L}^{-1}$ . By contrast, water emerging from limestone regions had alkalinity near  $160 \text{ mg L}^{-1}$ . When phosphorus and nitrogen fertilizers were added to low alkalinity water in ponds in a volcanic region, the growth of algae and subsequent yield of Nile Tilapia were low:  $1.1 \text{ g C m}^{-1} \text{ day}^{-1}$  and  $1080 \text{ kg fish ha}^{-1}$  per 150 day grow-out period respectively. With low alkalinity, carbon dioxide limited pond production, and phosphorus and nitrogen remained in pond water unused by the algae. When alkalinity was increased to  $50-60 \text{ mg L}^{-1}$  and fertilizer was applied at the same rate, algae productivity and fish yield increased to  $1.5 \text{ g C m}^{-2} \text{ day}^{-1}$  and  $1475 \text{ kg fish ha}^{-1}$  per 150 day grow-out period. With increased abundance of  $\text{CO}_2$  and increased growth of algae, phosphorus and nitrogen uptake from pond water increased, thus improving fertilizer efficiency.  $\text{CO}_2$  continued to be in short supply at the highest levels of pond production obtained in the experiment. Fertilizer applied at the same rate to ponds in limestone drainage systems of Java with greater alkalinity would likely support pond productivity in excess of that obtained here. This work shows that  $\text{CO}_2$  availability needs to be assessed during design of fertilizer application schemes in order to use fertilizers economically and to obtain consistent fertilizer-based yields from site to site in Java.

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