*Original Article*

Indian Journal of Biology
Volume 1 Number 1, January - June 2014

# Efficacy of Effluent Treatment System for the Reduction of Nutrient and Organic Loads in Semi-intensive Shrimp Farming Ponds

**B. Guha*, B.M.A. Hasan**, S. Datta*****

**Abstract**

Commercial shrimp farming poses a threat to coastal ecosystem by discharging huge amount of organic and nutrient loads beyond its self-cleansing capacity. Clustering of farms, overstocking of shrimp and consequent high inputs of feed during shrimp culture resulted degradation of the adjoining environment and caused huge mortality of cultured shrimp due to disease outbreak. In an effort to reduce the potential negative impacts in terms of nutrient and organic load in shrimp culture and making shrimp farming sustainable, modified effluent treatment system (ETS) was used to evaluate its efficacy in a semi-intensive shrimp farm of West Bengal, India. ETS was composed of two types of ponds: (i) sedimentation pond, and (ii) bio-filtration pond, and was placed beyond the culture pond outlet. After 120 days of culture it was found that the concentration of different potential nutrients and organic load parameters (ammonia, nitrite, nitrate, phosphate, 5-days biochemical oxygen demand, total suspended solid, Chlorophyll *a*) were increased substantially in the effluents at pond outlet, and decreased after ETS treatment for 6 days before final disposal. The results substantiated the efficacy of ETS as one of the effective propositions in minimizing environmental pollution, maintaining ecological sustainability and avoiding self pollution in commercial shrimp farms.

**Keywords:** Effluent treatment system; Nutrient load; Organic load; Semi-intensive; Shrimp culture.

## Introduction

Fate of shrimp farm effluents is a matter of great concern and environmental issues, which have always been the point of debate in shrimp farm development.[1,2] Shrimp farm effluents containing high concentrations of nutrients and organic matter from a large number of shrimp farms often discharged into coastal water, the effects can be negative, depending on ecosystem's capacity to receive the discharges. Potential negative effects includes: (i) unusual rates of sedimentation; (ii) eutrophication with increased risk of harmful algal blooms; (iii) change in the nutrient cycle; (iv) oxygen depletion; (v) toxicity from sulfide compounds and ammonia following degradation of organic matter; and (vi) increased incidence of disease, stemming from poor water quality and stress on marine life.[3-5] These impacts were found to be detrimental to the farm itself, to the neighboring farms, and also to the surrounding environment.[6] Major ecological impacts of shrimp farming are the discharges of suspended solid and nutrient rich water into coastal areas that may cause severe damage to the ecosystem.[7-9] The problems most frequently caused in shrimp farms are pollution of adjacent water bodies with nutrients, organic matter and accumulation of suspended matter discharged from untreated effluents.[10-11] However, shortage of clean water supply and insufficient waste removal in commercial shrimp farms leads to overloading of metabolites, environmental

**Author's Affiliation:** *Assistant Professor, **Research Scholar,Dept of Zoology, Netaji Subhas Open University, Woodburn Park, Kolkata - 700020, West Bengal, India, ***Assistant Professor,Fishery , New Alluvial Zone, Bidhan Chandra Krishi Viswavidalalya, Gayeshpur-741234, Nadia, West Bengal, India.

**Reprint's request: B. Guha,** Netaji Subhas Open University, 1 Woodburn Park, Kolkata - 700020, West Bengal, India.E-mail: guha_bibhas@rediffmail.com

degradation, and thus the disease outbreak happened due to bad water quality.[1] Since shrimp farming *per se* does not necessarily have a significant adverse impact on the coastal environment, inappropriate practices and unplanned development have lead to a series of problems.[2,12] It was reported that the effluents from shrimp pond typically contain elevated concentration of dissolved nutrients, phytoplankton and suspended particulates as compared to influent water causing environmental deterioration.[13] While the impact of aquaculture activities to the environment was considered, the impact of total amount of wastes discharged from aquatic farms on ecosystem sustenance were not recognized, particularly from the sustainability point of view.[14] There are reports that a potentially viable alternative to combat ecological degradation/exploitation is biological treatment using oysters and macro-algae to remove suspended particulates and nutrients from the shrimp farm effluents.[15-16] Several culture methods have been proposed to ameliorate the impact of shrimp pond effluents on the water quality of the recipient which included improved pond design;[5] reduction of water exchange rates;[17] combination of semi-closed system with settling and bio-filtration ponds using polyculture,[5] but the application of effluent treatment system (ETS) as a combination of both sedimentation and bio-filtration ponds in the field-level study are scanty.

Thus the present study aimed to evaluate the efficacy of ETS in a semi-intensive shrimp culture system in West Bengal, India to improve the quality of effluents, in terms of reduction of nutrient and organic loads, prior to discharge into receiving water bodies.

## Materials and Methods

### *Study Site*

*Penaeus monodon* Fabricius was cultured by semi-intensive method during April to August, 2011 in the ponds of Kar shrimp farm at Keshabpur in the district of East Medinipur, West Bengal, India (Lat. 21°55' N, Long. 88°46' E). Three experimental ponds with ETS facility were randomly selected in same row of the farm; distanced 200 meter and 1200 meter away from creek and other farms, respectively. All the ponds were uniform in size (0.5 hectare and rectangular) and having both inlet and outlet facilities.

### *Experimental Design*

The experiment was designed to treat the

**Figure 1(a): Layout of ponds with ETP and sampling points in outlined boxes**