Introduction

and

Objectives of Work
Introduction

Aquaculture plays an important role in Indian economy and is intricately linked with the socio-economic condition of the fish farmer. Due to the environmental issues and risks related to shrimp farming (particularly *Penaeus monodon*), the aquaculturists of the present day have mostly diverted their interest towards farming of freshwater prawn, *Macrobrachium rosenbergii* (De Man). This shellfish species has high demand in both domestic and export markets due to its price, taste, fast growth rate, less susceptibility to diseases and compatibility for polyculture practices. In a successful prawn culture practice and subsequent marketing prospect, the primary thrust is imparted to the dietary protein content as well as quality of the product. The retention of dietary protein for growth is the main goal of fish nutrition researchers for development of cost-effective diets (Jintasataporn et al., 2004). It has been observed from a series of pilot projects that successful and sustainable aquaculture is a direct function of proper feed which should be nutritionally balanced, eco-friendly and sustainable. Under natural conditions, *M. rosenbergii* is an omnivore and bottom feeder (Correia et al., 1998), feeding on various plant and animal materials (Balazs and Ross, 1976) and can efficiently digest both plant and animal proteins (Ashmore et al., 1985). Enzyme activity measured in the digestive tract of this prawn exhibits the presence of wide ranges of digestive enzymes including trypsin, amino peptidases, amylases, cellulase, protease, esterases and lipases which indicates the capability of this species to digest a relatively large range of complex proteins, carbohydrates and lipids (Tyagi and Prakash, 1967; Murthy, 1977; Fair et al., 1980; Lee et al., 1980). The type of ingredients generally used for feed preparation include components such as prawn head meal/ trash fishmeal, chicken offals, clam meat, silk worm pupae, meat and bone meal, mussel meat meal, squid meal, various cereal grains, oil seed cakes
and several other animal husbandry and agro by-products locally available in the region. Fishmeal is the major source of protein in a prawn diet because it is palatable and provides an excellent balance of essential amino acids and fatty acids as well as highly digestible energy (Tacon, 1999). The rapid growth of aquaculture has resulted in higher demand for fishmeal and consequently its price is expected to be further increased by continuous growth in its requirement (Hardy and Tacon, 2002). Search for new alternative protein sources including cheaper plant or animal origin proteins is essential to be introduced for stable aquafeed production (Higgs et al., 1995). Currently, extensive researches are being performed focusing towards sustainable substitutions for fishmeal with floral components. It is suggested that the use of floral components in fish diets can reduce the percentage of fishmeal and hence the overall costing of feeds (Lim and Lee, 2009). Production performance in an aquaculture experiment usually depends upon two economically important traits like overall growth and body weight of the target species. However, these traits are directly linked to the growth of the skeletal muscle which constitutes most of the somatic tissue. It is therefore imperative to understand the relationship between the skeletal muscle development and growth. Nevertheless such studies are still in their nascent stages in *M. rosenbergii*.

The Gangetic delta at the apex of Bay of Bengal offers a congenial environment in terms of hydrological parameters for the growth and culture of freshwater prawns (Mitra et al., 2007b; Mondal et al., 2013). It sustains Sundarbans mangrove forest which is a highly productive ecosystem with productivity about twenty times more than average oceanic production (Gouda and Panigrahy, 1996). Moreover, it is a detritus-based ecosystem and the detritus produced saturates the ambient water with nutrients which triggers the growth and development of planktonic community in the
water bodies on which the fishery resource is also dependent. This unique coastal ecosystem of the world sustains rich floral and faunal community in and around its vicinity. The production of litter and detritus matter from mangrove plants fulfill the nutritional requirements of prawn juveniles, adult shrimps, molluscs and fishes of high economic value residing within the system. The associate floral community includes salt-marsh grass, sea-grass, sand binders and seaweeds. The seaweeds such as, *Enteromorpha intestinalis* (Chlorophyceae), *Ulva lactuca* (Chlorophyceae) and *Catenella repens* (Rhodophyceae) are the dominant ones found in Indian Sundarbans. Similarly salt-marsh grass, *Porteresia coarctata* occurs abundantly in the intertidal mudflats. Moreover, mangrove litter also forms a basis of nutrition for the marine and estuarine benthic community (Odum and Heald, 1975). For each and every floral species an optimum salinity range exists that is important for their growth and survival. The floral components selected for inclusion in prawn feed preparation in the present programme are:

- Green seaweed, *Enteromorpha intestinalis* because of its wide range of salinity tolerance (2-30 psu) as well as considerable protein content (Mitra and Banerjee, 2006).
- Salt-marsh grass, *Porteresia coarctata* because of their abundance, important source of animal fodder and protein content (Mitra and Banerjee, 2006).
- Mixed mangrove litter as they already serve the requirement of nutrition for benthic community and also for their biochemical composition (Hoq *et al.*, 2002).
The work is an attempt to partially reduce the traditional animal ingredient (fishmeal/prawn shell dust/dried molluscs) of prawn feed with the above mentioned selected flora as ingredients that are widely available in mangrove region of Indian Sundarbans. The impact on the culture species (*M. rosenbergii*) in terms of morphological, biochemical and histological characteristics were evaluated after the application of formulated feeds of mangrove floral origin.

Thus the present programme has four important components and can be linked with ecosystem services:

(i) Boost up per unit production of *M. rosenbergii* (Economic service).

(ii) Upgrade hydrological condition of the culture system (Environmental service).

(iii) Partially replace fishmeal so as to reduce the costing of feed (Livelihood service).

(iv) Alternative livelihood and income generation for the coastal population of Indian Sundarbans (Livelihood and Economic service).
Objectives of Work

- To determine the proximate composition of the formulated prawn feeds incorporated with selected floral ingredients (*viz.* *Enteromorpha intestinalis*, *Porteresia coarctata* and mangrove litter).

- To evaluate the efficacy of mangrove based feed in maintaining the pond environment (preferably hydrology and bottom soil organic carbon).

- To evaluate the morphological characteristics (in terms of growth and production performance) like condition factor, specific growth rate, average body weight, length-weight relationship, survival and feed conversion ratio of *Macrobrachium rosenbergii* due to application of mangrove based feed.

- To determine the biochemical characteristics in *Macrobrachium rosenbergii* due to application of mangrove based feed.

- To determine the muscle histological characteristics in *Macrobrachium rosenbergii* due to application of mangrove based feed.

- To estimate the economic viability for each type of formulated feed through benefit - cost ratio analysis (BCR).