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Impact of *Salicornia* -based feed on the Growth and production Performance Parameters of Freshwater Prawn *Macrobrachium rosenbergii* (De Man, 1879)

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Abstract

We carried out a pilot scale study on the application of Salicornia-based feed on *Macrobrachium rosenbergiiin* 2021 for a period of 240 days in Bali Island of central Indian Sundarban. The formulated feed was provided to the cultured species in the experimental pond and compared with those in the control pond where the commercial variety of prawn feed was used. Our first order analysis reflects the positive role of Salicornia-based prawn feed on both abiotic and biotic parameters like soil quality, water quality, condition index, survival rate and FCR value. ANOVA carried out with the culture results exhibit significant variations between the pond types and days for all the selected parameters, thus confirming the efficacy of Salicornia-based feed for *M. Rosenbergiii* culture.

Keywords: Macrobrachium rosenbergii*; Salicornia-based feed; Soil quality; Water quality; Zoo-technical parameters*

Introduction

Aquaculture in India is presently flourishing at a rapid pace to meet the growing demand of protein. The aquaculture sector encompasses the culture of a wide range of aquatic organisms, but the focus is mainly on shrimp *(Penaeus monodon, Litopenaeus vennamei & Macrobrachium rosenbergii De Man)*. The farmers of the present day are showing more inclination towards freshwater prawn farming because of its fast growth rate, disease resistant potential and adaptability to stressed environment unlike the shrimp species. In the domain of aquaculture, feed constitutes a vital sector because of its regulatory influence on the survival, growth, and immunity of the species. In context to economic viability, feed constitutes a major input cost for production. However, the commercial feed used by the farmers consists of animal ingredients like shrimp dust, fish meal etc., which commonly poses an adverse impact on the water and soil quality of the culture pond through uneaten feed, faecal matter etc. The significant amounts of uneaten and undigested feed resulting from shrimp feeding accumulate at the bottom of the pond and become decomposed by microorganisms [1]. The major pollutants released from the uneaten feed are organic carbon, ammonia, hydrogen sulphide, phosphorus etc. that not only deteriorate the water and soil quality, but also trigger eutrophication and HAB species. Faecal matter is a major waste that generate during the process of digestion in fish. Nitrogen and phosphorus are primarily contributed by the faecal matter of the culture species that cause algal bloom in water bodies [2]. Based on the adverse impacts of the animal ingredients of the fish feed, many researchers have initiated to replace the animal ingredients with floral parts [3]. Prawn feed supplemented with selected floral ingredients may vary according to consumer species, the type of ingredient and their respective inclusion level. Definitely the ingredients selected in the present study and their inclusion in *M. rosenbergii* feed is the pioneer work from the present study region. A similar approach was undertaken by researchers through inclusion of floral ingredients in different regions of Indian subcontinent, but they were mostly connected to replacement of animal protein with terrestrial plant proteins. In this context, Md. Hasanuzzaman et al. [4] observed better weight gain, SGR and survival in *M. rosenbergii* fed diets including 70g kg^{-1} Murrayakoenigi extract. Similarly, Banerjee et al. [5] also observed significantly better growth performance and body pigmentation of *P. monodon* fed with formulated feed containing 50g kg^{-1} of red seaweed, *Catenella repens* from Sundarbans. Inclusion of salt-marsh grass, *P. coarctata* in feedof *P. monodon* at 100g kg^{-1} is also reported by Mitra et al. [6] with better growth performance and low FCR. Mondal et al. [3] observed a better growth in *M. rosenbergii* through inclusion of *E. intestinalis* and *P. coarctata* in the feed. The inclusion of decomposed mangrove leaves or foliage in feed of *Metapenaeus monoceros* have been reported previously with better growth and conversion efficiency [7,8].

Considering the importance of prawn culture and utilities of floral based fish feed, the present study was undertaken at Bali Island in central Indian Sundarban to examine the effects of the mangrove associate-based formulated feed on the growth and production of prawn.

Materials and Methods

Study area

Salicornia brachiata was collected from the field during 2021 in the month of February (post monsoon season) from Bali Island (22°05′44.1″N; 88°46′38.1″E) in central Indian Sundarban. The central part of Indian Sundarban is hypersaline in nature due to siltation of the Bidyadhari since the 15th century [9-17] and hence offers a favorable environment for the growth of this mangrove associate species. During collection, biomass was estimated through quadrat method (1m × 1m) to assess the productivity in tonnes ha^{-1} with the idea to scale up the Salicornia-based prawn feed preparation.

Proximate analysis of *S.brachiata* and *S. brachiata*-based formulated feed

The samples were preserved at -20°C and analyzed within 48 hours. The preserved samples were brought to normal room temperature, then excess water was soaked using Whatman filter paper. Samples were homogenized and used for biochemical analysis. The composition of the prawn muscle was determined by following the standard methods: Kjeldhal for protein [18], Dubois for carbohydrate [19] and Soxhlet for lipid [20]. The extinction values were measured by spectrophotometer.

Formulation of *S. brachiata*-based feed

The experimental feed was designed according to the nutritional requirements of prawns [21]. The floral ingredients were incorporated at a level of 30% within the feed by reducing fish meal. A control feed was also formulated with 0% reduction of fish meal (Table 1).

Table 1: Composition of ingredients used for fish feed preparation for control and experimental ponds.

Ingredients	Control Pond	Experimental Pond
Fish meal	30.0	25.0 (*S. brachiata*leaf dried and powder)
Shrimp meal	5.0	5.0 (*S. brachiata*stem dried and powder)
Soybean meal	5.0	10.0
Mustard oilcake	10.0	10.0
Sesame meal	10.0	10.0
Wheat bran	20.0	20.0
Rice bran	18.0	18.0
Oyster shell	1.0	1.0
Vitamin premix	1.0	1.0
Total	100	100.0

The feed ingredients were chosen based on their nutritional status, price and year-round availability in the local market. The ingredients were weighed properly followed by a uniform mixture. The resulting mixture was steam cooked, cooled at room temperature, and finally pressed through a manual feed pelletizer. The pellets were dried in well aerated place under the shade for 2 days until it became sufficiently dry. Finally, they were packed and stored for further use.

Pond preparation

The pond was dewatered with pump and the bottom was sun-dried for one month to allow excavate of the bottom mud and to complete digging of the experimental ponds; thus, aquatic weeds and unwanted fauna were removed. The embankments of the pond were repaired and constructed. After testing soil pH, liming was done at a dose 250kg/ha ($CaCO_3$) that helps to maintain good water quality. The pond was filled with water to a depth of about 2m.

Stocking

Prawn seeds were procured from a local hatchery and acclimated to the pond conditions prior to feeding trial. Seeds were stocked at a density of 2 individuals/m^2 with average initial weight of approximately 0.58 gm. The stocking was done in the month of March, 2021 in both the control and culture ponds.

Feeding trial

A feeding trial was carried out at Bali Island (22°04'35.17"N; 88°44'55.70"E) in central Indian Sundarban in two grow-out farm conditions for 240 days of experimental duration. The experimental approach consisted of dietary treatment for two types of ponds, namely control and experimental. In the control pond,

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commercial feed available in the local market was provided and in the experimental pond, the *Salicornia*-based formulated feed was given throughout the culture periods of 8 months (March, 2021 – October, 2021). Each pond was well connected to the adjacent estuary so that possible hydrological variations affect all the ponds simultaneously.

Monitoring of hydrological and soil parameters of the culture ponds

Analysis of physico-chemical variables like surface water temperature, surface water pH, surface water salinity, dissolved oxygen, dissolved nutrients (nitrate, phosphate and silicate), chlorophyll a were carried out in every month as per the method outlined by Strickland and Parsons (1972).

Soil samples from the upper 5cm of the pond were collected from 10 plots, randomly selected and dried at 60°C for 48 hrs. For Soil Organic Carbon (SOC) analysis, visible plant particles were handpicked and removed from the soil. After sieving the soil through a 2mm sieve, the samples of the bulk soil (50gm from each plot) were ground finely in a ball - mill. The fine dried sample was randomly mixed to get a representative picture of the culture pond. Modified version of Walkley & Black method [22] was then followed (as depicted in the flow chart) to determine the organic carbon of the soil in % (Figure 1).

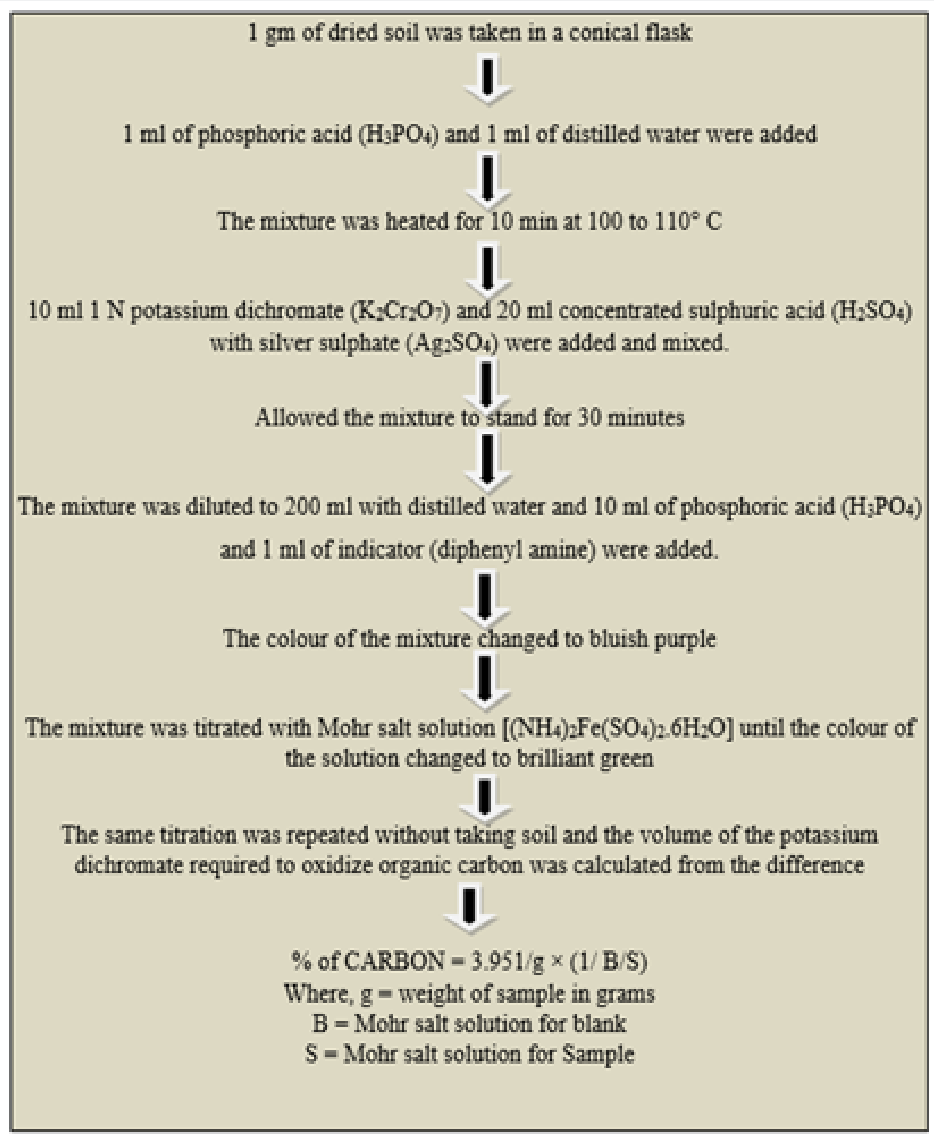

Figure 1: Estimation of soil organic carbon by Walkley and Black method [22]..

Results

Proximate analysis of *S. brachiata* and formulated feed

S. brachiata has considerable protein and mineral contents due to which the species can be used as one of the ingredients of prawn feed (Table 2 & Figures 2-4).

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Table 2: Proximate composition in *S. brachiata* and *S. brachiata*-based formulated feed.

Species & Product	Total Protein (%)	Total Carbohydrate (%)	Total Fat (%)	Total Fibre (%)	Ca (%)	Na (%)	K (%)
Salicornia brachiata	18.81	58.15	0.95	4.70	2.23	4.24	2.65
Control feed	25.92	30.34	2.81	7.88	0.66	0.25	0.42
Formulated feed	23.17	60.79	0.81	7.96	2.05	2.38	2.85

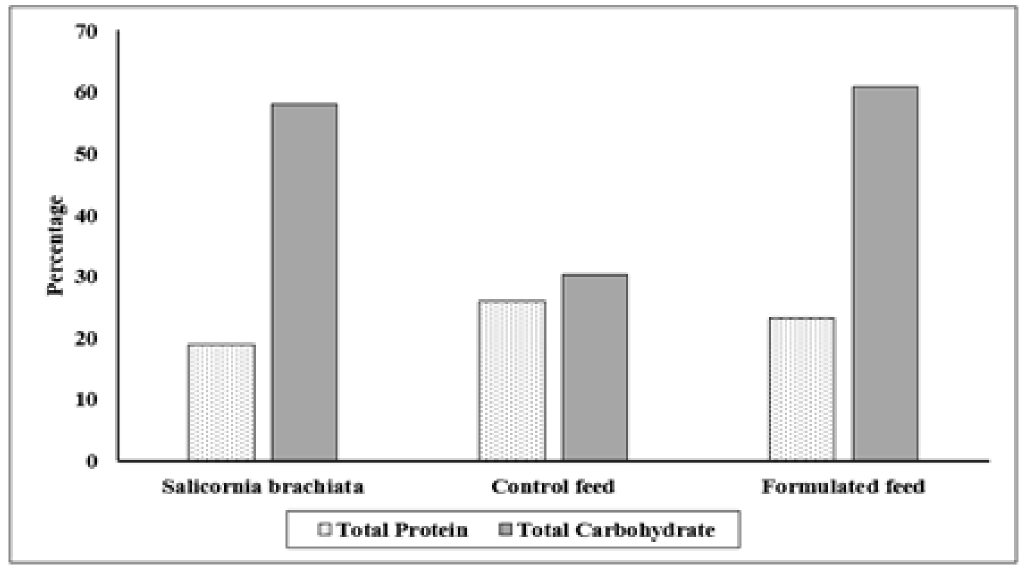

Figure 2: Total protein and total carbohydrate levels (in %) in *S. brachiata* and *S. brachiata*-based feed.

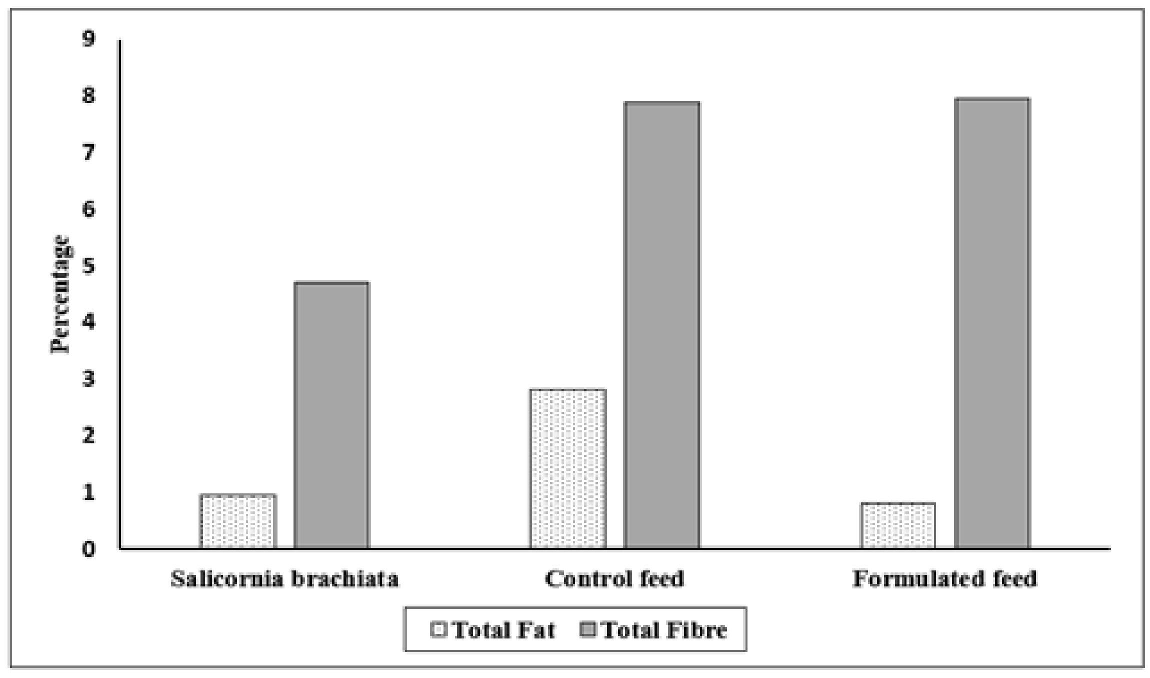

Figure 3: Total fat and total fibre levels (in %) in *S. brachiata* and *S. brachiata*-based feed.

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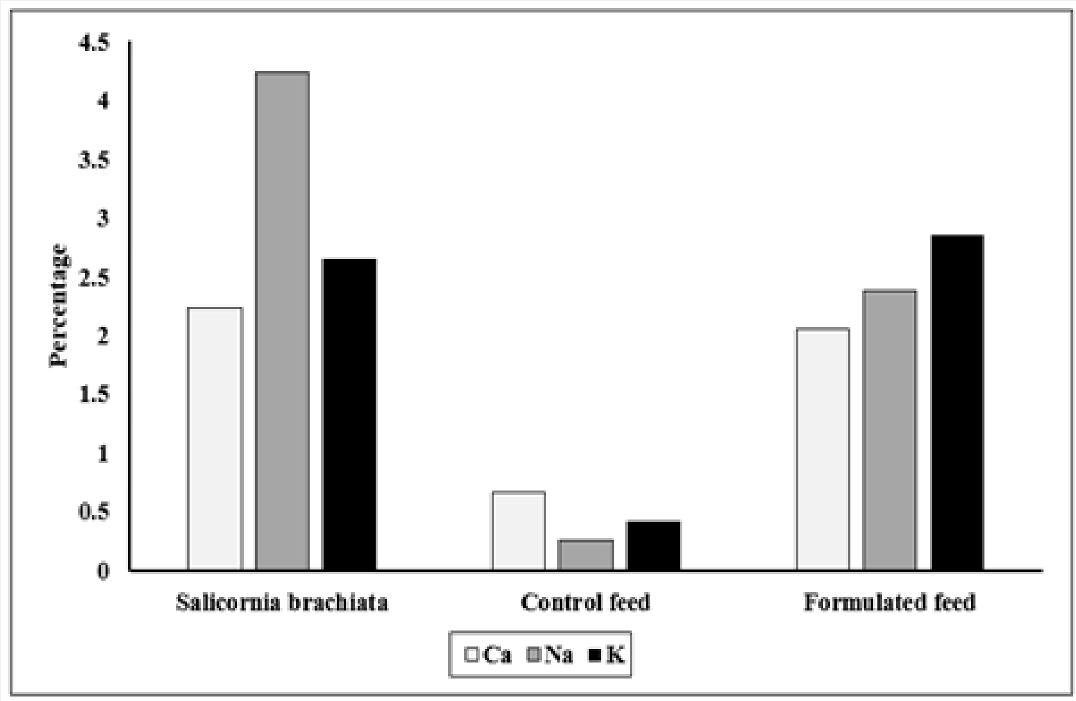

Figure 4: Ca, Na and K levels (in %) in *S. brachiata* and *S. brachiata*-based feed.

Hydrological parameters

The feed prepared from the vegetative parts (leaf and stem) of the mangrove associate species also upgraded the water in terms of dissolved oxygen, surface water pH, nutrients and soil organic carbon (Tables 3-10 & Figures 5-13).

Table 3: Water and soil quality of control and experimental ponds during March, 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	31.1	31.3
Surface water pH	8.09	8.21
Surface water salinity (psu)	9.36	9.78
Dissolved oxygen (ppm)	5.23	6.02
Dissolved Nitrate (μgm at l^{-1})	17.95	17.02
Dissolved Phosphate (μgm at l^{-1})	2.88	2.79
Dissolved Silicate (μgm at l^{-1})	65.95	6.89
Phytopigment (chlorophyll a) (mg m^{-3})	7.23	6.28
Soil Organic Carbon (%)	1.65	1.62

Table 4: Water and soil quality of control and experimental ponds during April 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	33.0	33.1
Surface water pH	8.02	8.17
Surface water salinity (psu)	11.44	11.40
Dissolved oxygen (ppm)	5.01	6.11
Dissolved Nitrate (μgm at l^{-1})	18.85	18.02
Dissolved Phosphate (μgm at l^{-1})	8.05	2.98
Dissolved Silicate (μgm at l^{-1})	65.83	64.24
Phytopigment (chlorophyll a) (mg m^{-3})	8.13	6.06
Soil Organic Carbon (%)	1.96	1.71

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Table 5: Water and soil quality control and experimental ponds during May, 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	35.1	35.3
Surface water pH	7.98	8.02
Surface water salinity (psu)	14.02	13.98
Dissolved oxygen (ppm)	4.91	6.13
Dissolved Nitrate ($^{\mu}$gm at l^{-1})	20.34	16.98
Dissolved Phosphate ($^{\mu}$gm at l^{-1})	3.18	2.93
Dissolved Silicate ($^{\mu}$gm at l^{-1})	65.80	62.05
Phytopigment (chlorophyll a) (mg m^{-3})	9.23	6.02
Soil Organic Carbon (%)	1.98	1.70

Table 6: Water and soil quality of control and experimental ponds during June 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	36.9	37.1
Surface water pH	7.35	8.15
Surface water salinity (psu)	16.08	15.23
Dissolved oxygen (ppm)	4.65	6.28
Dissolved Nitrate (μgm at l^{-1})	21.82	15.11
Dissolved Phosphate (μgm at l^{-1})	3.56	2.69
Dissolved Silicate (μgm at l^{-1})	65.95	64.66
Phytopigment (chlorophyll a) (mg m^{-3})	12.02	7.18
Soil Organic Carbon (%)	2.18	1.77

Table 7: Water and soil quality control and experimental ponds during July 2021.

Parameters	Control Pond	Experimental pond
Surface water temperature (°C)	37.2	37.5
Surface water pH	7.49	8.14
Surface water salinity (psu)	7.02	7.15
Dissolved oxygen (ppm)	4.60	6.21
Dissolved Nitrate (μgm at l^{-1})	24.10	15.05
Dissolved Phosphate (μgm at l^{-1})	3.81	2.53
Dissolved Silicate (μgm at l^{-1})	65.82	63.82
Phytopigment (chlorophyll a) (mg m^{-3})	14.20	6.02
Soil Organic Carbon (%)	3.60	1.38

Table 8: Water and soil quality of control and experimental ponds during August 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	38.0	37.7
Surface water pH	7.41	8.12
Surface water salinity (psu)	6.08	6.14
Dissolved oxygen (ppm)	4.53	6.22
Dissolved Nitrate (μgm at l^{-1})	25.42	14.24
Dissolved Phosphate (μgm at l^{-1})	4.31	2.49
Dissolved Silicate (μgm at l^{-1})	65.86	62.95
Phytopigment (chlorophyll a) (mg m^{-3})	16.28	5.93
Soil Organic Carbon (%)	4.13	1.41

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Table 9: Water and soil quality control and experimental ponds during September 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	37.3	37.1
Surface water pH	7.38	8.16
Surface water salinity (psu)	5.14	5.24
Dissolved oxygen (ppm)	4.29	6.44
Dissolved Nitrate (μgm at l^{-1})	29.02	14.08
Dissolved Phosphate (μgm at l^{-1})	4.82	2.36
Dissolved Silicate (μgm at l^{-1})	65.82	6.39
Phytopigment (chlorophyll a) (mg m^{-3})	17.33	5.01
Soil Organic Carbon (%)	4.17	1.05

Table 10: Water and soil quality control and experimental ponds during October 2021.

Parameters	Control Pond	Experimental Pond
Surface water temperature (°C)	36.3	36.7
Surface water pH	7.24	8.20
Surface water salinity (psu)	5.02	5.05
Dissolved oxygen (ppm)	4.17	6.41
Dissolved Nitrate (μgm at l^{-1})	31.06	13.44
Dissolved Phosphate (μgm at l^{-1})	4.89	2.36
Dissolved Silicate (μgm at l^{-1})	66.02	66.29
Phytopigment (chlorophyll a) (mg m^{-3})	18.05	5.20
Soil Organic Carbon (%)	4.21	1.05

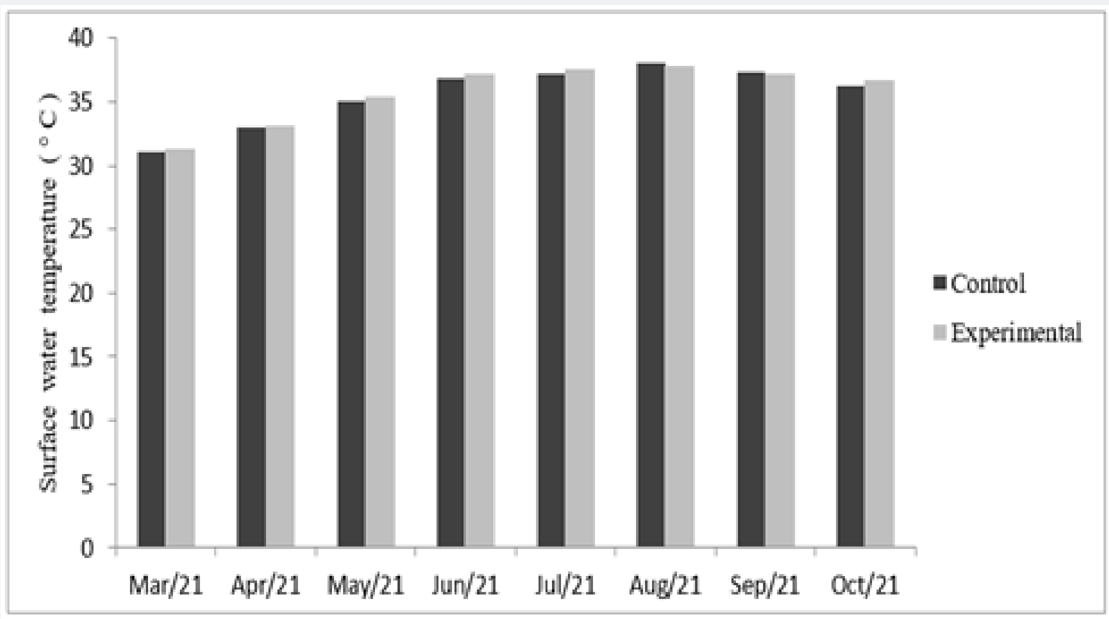

Figure 5: Monthly variation of surface water temperature (°C) in both control and experimental ponds.

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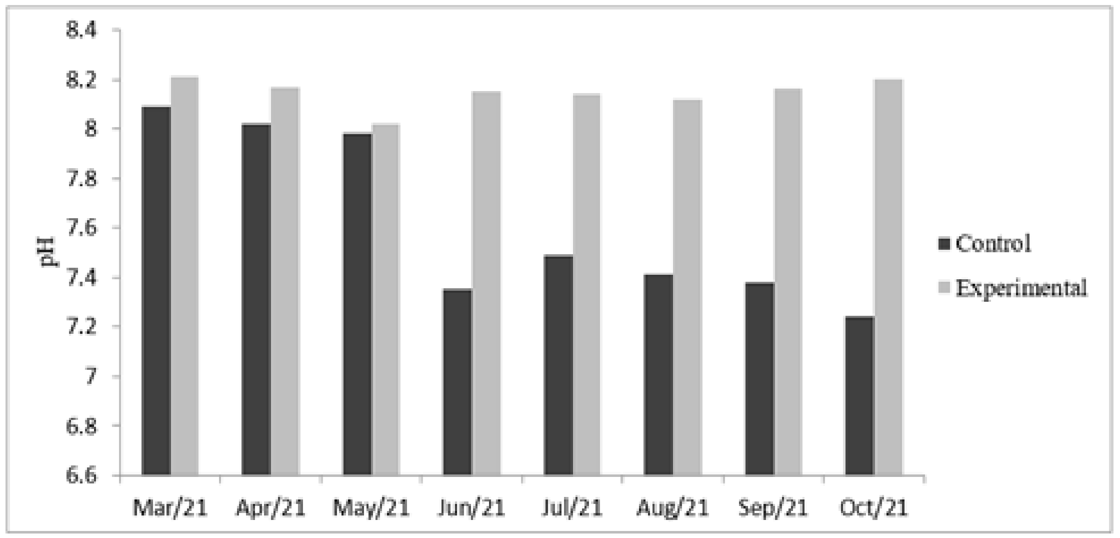

Figure 6: Monthly variation of surface water pH in both control and experimental ponds.

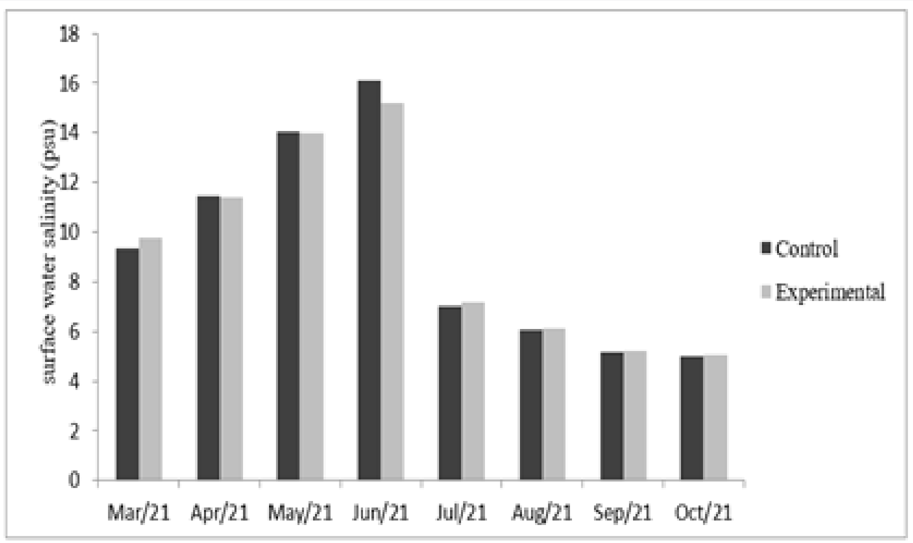

Figure 7: Monthly variation of surface water salinity (psu) in both control and experimental ponds.

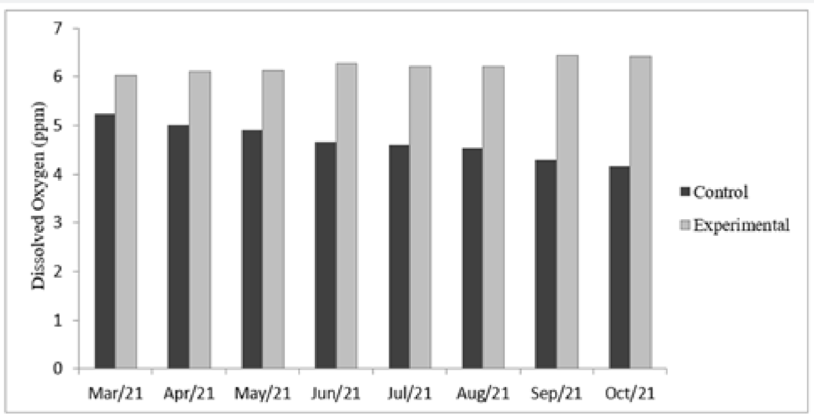

Figure 8: Monthly variation of dissolved oxygen (ppm) in both control and experimental ponds.

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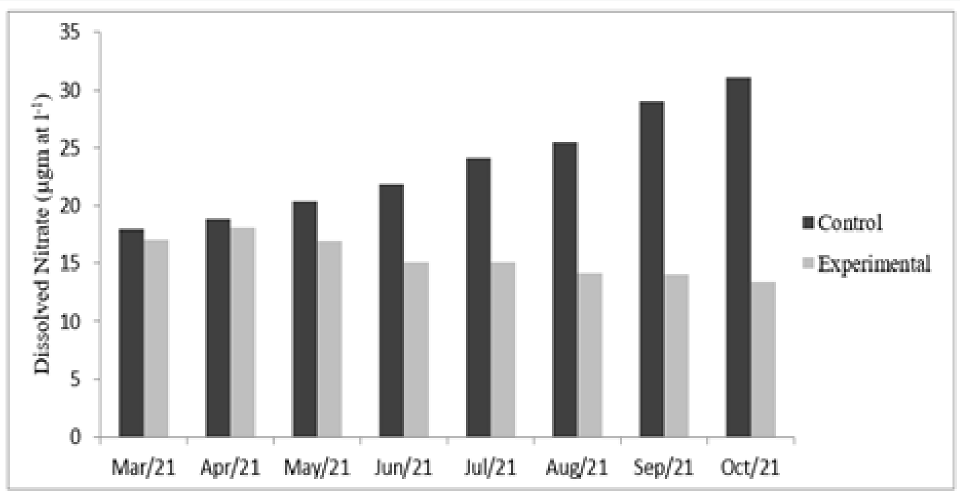

Figure 9: Monthly variation of dissolved nitrate (µgm at l^{-1}) in both control and experimental ponds.

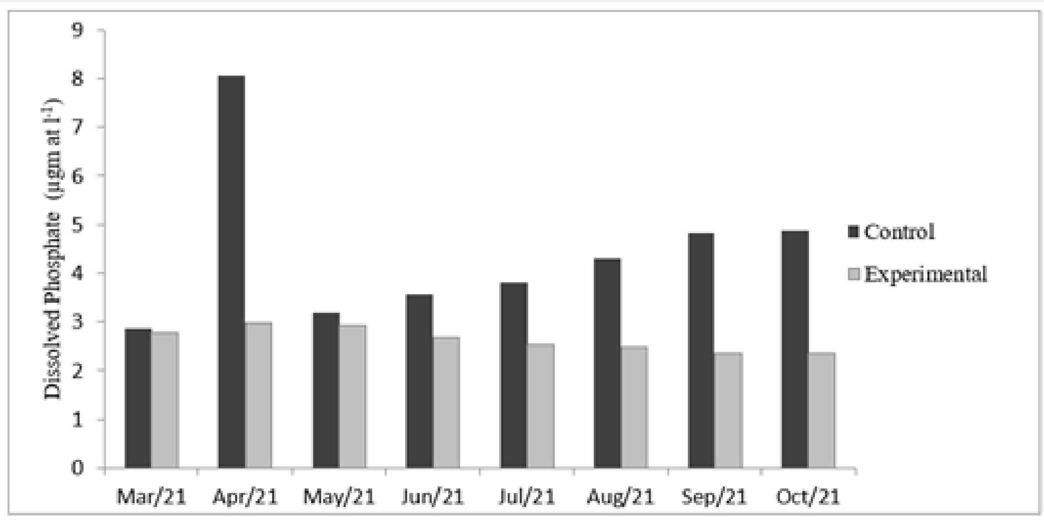

Figure 10: Monthly variation of dissolved phosphate (µgm at l^{-1}) in both control and experimental ponds.

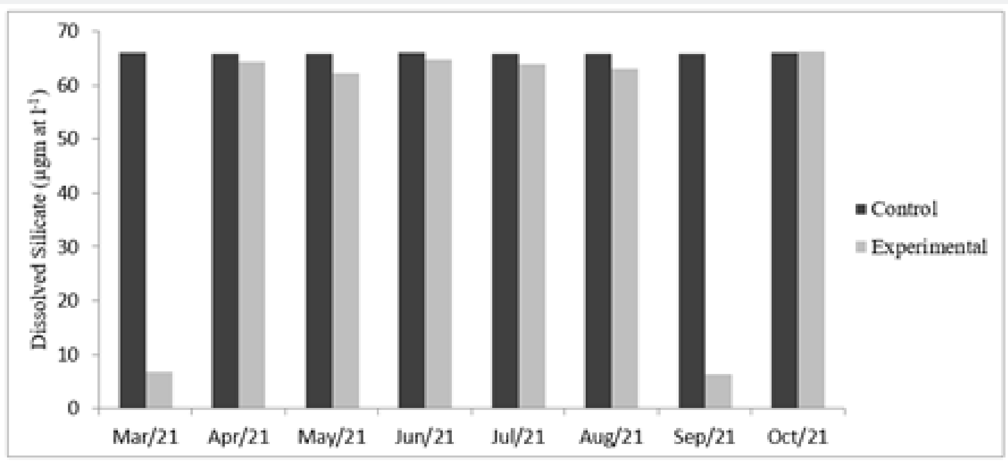

Figure 11: Monthly variation of dissolved silicate (µgm at l^{-1}) in both control and experimental ponds.

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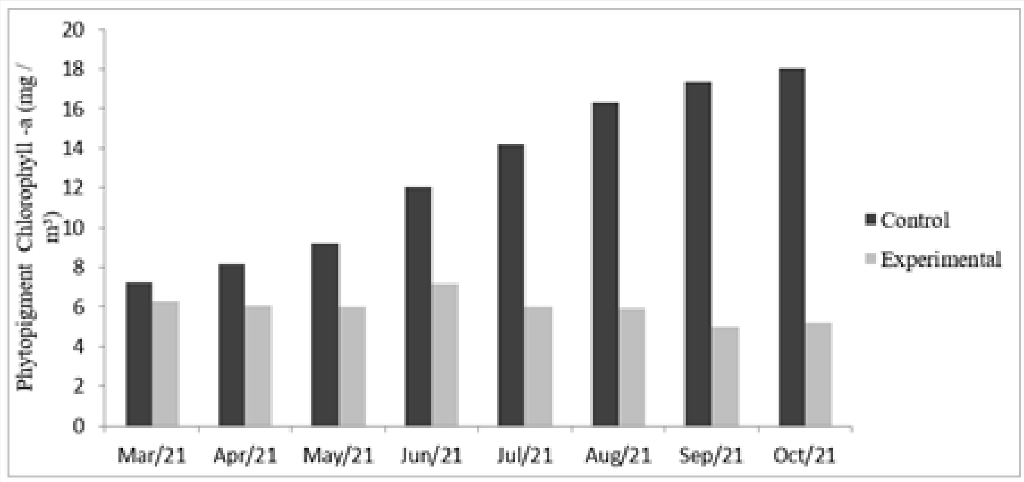

Figure 12: Monthly variation of phytopigment (chlorophyll a) (mg m^{-3}) in both control and experimental ponds.

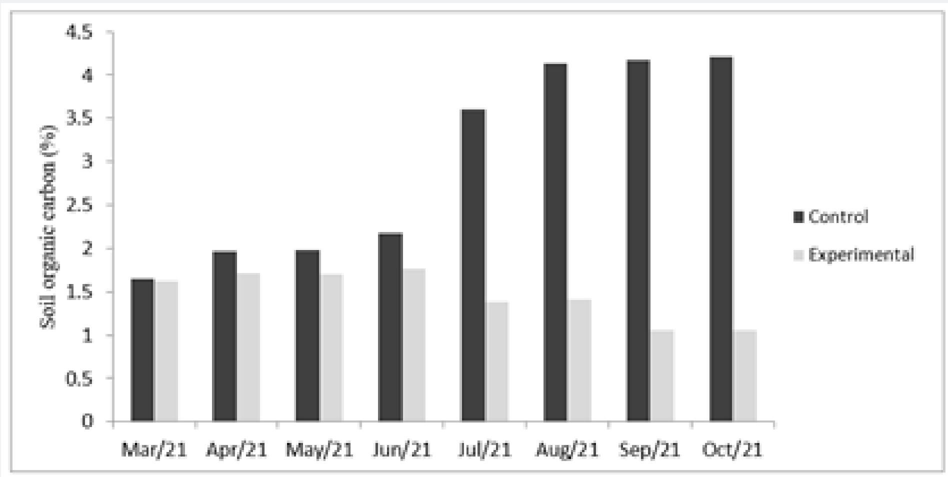

Figure 13: Monthly variation of soil organic carbon (%) in both control and experimental ponds.

Zoo-technical parameters

Application of *Salicornia*-based prawn feed in the experimental pond improved the Condition Index (CI) of the cultured species compared to the control pond (Table 11). ANOVA carried out on weight, length and CI of the cultured prawn species exhibit significant variations between days and pond types (Tables 12-14).

These results clearly indicate that the health of the cultured prawn species is better in the experimental pond compared to the control pond. The beneficial role of *S. brachiata*-based feed is thus confirmed through higher CI values in the experimental pond compared to the cultured prawn species in the control pond (Figure 14).

Table 11: Variations of weight, length and Condition of Index (CI) of *M.rosenbergii* in Control (C) and Experimental (E) ponds at different Date of Culture (DOC).

DOC	Weight (gm)		Length (cm)		CI	
	C	E	C	E	C	E
1st day	0.59	0.58	4.29	4.31	0.74	0.72
30th day	1.91	2.02	6.36	6.40	0.74	0.77
60th day	7.13	7.70	9.38	9.31	0.86	0.95
90th day	14.86	16.56	11.95	11.85	0.87	0.99
120th day	26.44	33.79	14.06	13.93	0.95	1.25
150th day	32.02	40.84	14.95	14.46	0.95	1.35

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180th day	40.63	47.78	15.39	15.08	1.11	1.39
210th day	50.81	50.97	17.64	17	0.92	1.03
240th day	71.38	86.53	18.92	18.09	1.05	1.46

ANOVA carried out on weight, length and CI of the cultured prawn species exhibit significant variations between days and pond types (Tables 12-14).

Source of Variation	SS	df	MS	F	P-Value	F Crit
Between days	377.6086	8	47.20108	982.7303	3.73E-11	3.438101
Between pond types	0.350006	1	0.350006	7.287144	0.027096	5.317655
Error	0.384244	8	0.048031			
Total	378.3429	17				

Table 14: ANOVA of Condition Index between days and pond types for cultured prawn species.

Source of Variation	SS	df	MS	F	P-Value	F Crit
Between days	0.614444	8	0.076806	6.033166	0.009978	3.438101
Between days	0.164356	1	0.164356	12.91032	0.007053	5.317655
Error	0.101844	8	0.012731			
Total	0.880644	17				

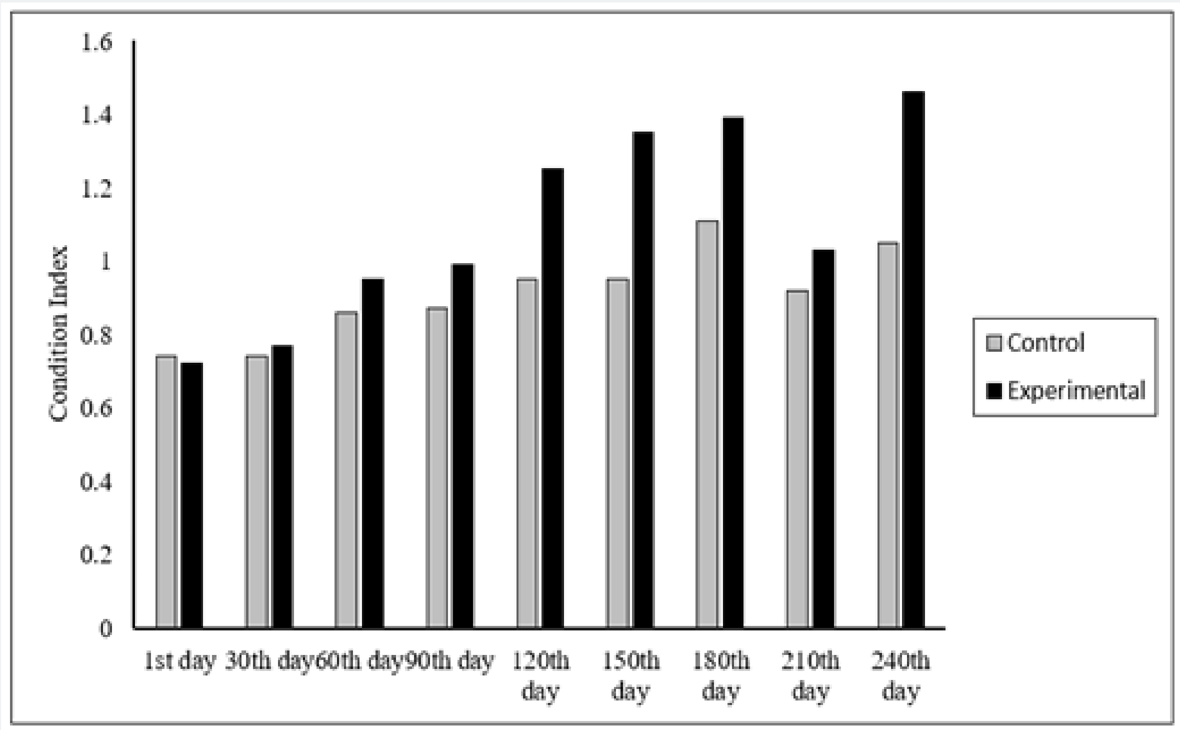

Figure 14: Condition Index of cultured prawn in both control and experimental ponds.

Discussion

The present research focuses on the effects of *Salicornia*-based prawn feed on the biological parameters like survival rate, condition Index and FCR value. We observed significant differences of these parameters between the control and experimental ponds. The condition index values were relatively high in the experimental pond compared to the control pond during the entire culture period (exception is the 1st day result during stocking). The FCR values were relatively low in the experimental pond, which confirms the efficacy of *Salicornia*-based prawn feed in the domain of freshwater prawn culture.

These contrasting differences between the ponds may be attributed to few factors like

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a) better water quality due to absence of animal ingredients in the formulated feed.

b) high mineral content of the Salicornia - based feed.

c) better digestive ability of the plant protein compared to the animal protein feed.

The production of prawns was higher in the pond treated with Salicornia-based feed compared to the control. The survival rate was 83% in the experimental pond which, is 9.2% higher than the control pond where the survival rate was 76%. To sum up, it can be stated that Salicornia-based prawn feed can serve as an innovative alternative livelihood for the island dwellers of Sundarbans as this formulated feed has several benefits like

a) upgradation of water quality

b) higher survival rate

c) faster growth

d) better Condition Index

e) lesser soil organic carbon

f) lesser FCR value.

Based on these benefits, introduction of Salicornia -based prawn feed is essential to improve both environmental and economic sectors associated with prawn culture.

Conclusion

Freshwater prawn culture has become a popular livelihood in the tropical countries. However, use of artificial feed for their culture often pollutes the pond water and makes their growth slow. Use of Salicornia -based prawn feed exhibits better growth and survival rate in the present research. Hence, such floral based feed formulation and their application should be scaled up to make the prawn culture more successful and sustainable.

References

1. Thornber B, Drikakis D, Youngs DL, Williams RJR (2010) The influence of initial conditions on turbulent mixing due to Richtmyer - Meshkov instability. Journal of Fluid Mechanics 654: 99-139.
2. Jasmin MY, Syukri F, Kamarudin MS, Karim M (2020) Potential of bioremediation in treating aquaculture sludge. Aquaculture 519.
3. Mondal K, Ghosh R, Bhattacharyya SB, Zaman S, Banerjee K, et al. (2013) Partial replacement of fishmeal with mangrove-based plant ingredients and its effect on water quality, growth performance and length-weight relationship of freshwater prawn *Macrobrachium rosenbergii*. Species 3(8): 15-21.
4. Md Hasanuzzaman AF, Md Siddiqui N, Md Chisty AH (2009) Optimum Replacement of fishmeal with Soybean Meal in Diet for *Macrobrachium rosenbergii* (De Man, 1879) Cultured in Low Saline Water. Turkish Journal of Fisheries and Aquatic Sciences 9(1): 17-22.
5. Banerjee K, Mitra A, Mondal K (2010) Cost-effective and eco-friendly shrimp feed from red seaweed *Catenella repens (Gigartinales: Rhodophyta)*. Current Biotica 8(1): 23-43.
6. Mitra A, Basu S, Banerjee A, Banerjee K (2007) Culture of Freshwater Prawn Using Feed Incorporated with Salt Marsh Grass, *Porteresia Coarctata* in Indian Sundarbans. Seshaiyana 15(1): 16-17.
7. Vijayaraghavan S, Ramadhas V (1980) Conversion efficiency in the shrimp, *Metapenaeus monoceros (Fabricius)*, fed decomposed mangrove leaves. Indian Journal of Marine Sciences 9: 123-125.
8. Vijayaraghavan S, Wafar S (1983) Further studies in using mangrove foliage as a prawn feed. Mahasagar - Bulletin of the National Institute of Oceanography 16(3): 309-316.
9. Chaudhuri AB, Choudhuri A (1994) Mangroves of the Sundarbans 1: India. IUCN, Bangkok, Thailand.
10. Mitra A (2000) The northeast coast of the Bay of Bengal and deltaic Sundarbans. In: Seas at the Millennium - An environment evaluation. In: Charles S, University of Warwick, U.K. Elsevier Science, pp: 143-157.
11. Banerjee K, Sengupta K, Raha AK, Mitra A (2013) Salinity based allometric equations for biomass estimation of Sundarban mangroves. Biomass Bioenergy 56: 382-391.
12. Mitra A (2013) Sensitivity of Mangrove Ecosystem to Changing Climate. In: Springer New Delhi Heidelberg New York Dordrecht London.
13. Raha AK, Bhattacharyya SB, Zaman S, Banerjee K, Sengupta K, et al. (2013) Carbon census in dominant mangroves of Indian Sundarbans. The Journal of Energy and Environmental Science 127: 345-354.
14. Sengupta K, Roy Chowdhury M, Bhattacharya SB, Raha AK, Zaman S, et al. (2013) Spatial variation of stored carbon in Avicennia alba of Indian Sundarbans. Discovery Nature 3(8): 19-24.
15. Mitra A, Zaman S (2014) Carbon Sequestration by Coastal Floral Community. In: The Energy and Resources Institute (TERI) TERI Press, India p. 1-4.
16. Mitra A, Zaman S (2016) Basics of Marine and Estuarine Ecology. In: Publisher Springer India, pp. 1-481.
17. Mitra A (2019) Estuarine Pollution in the Lower Gangetic Delta. In: Springer International Publishing 16: 371.
18. Tecator AB (1987) Determination of Kjeldahl nitrogen content with kjeltec system 1026. Application note AN 86/87 (1987.02.18). Kjeltec 1026 Manual, Tecator AB, Sweden.
19. Dubois M, Gilles KA, Hamilton JK, Rebers PA, Smith F (1956) Colorimetric method for determination of sugars and related substances. Analytical Chemistry 28(3): 350-356.
20. Folch J, Lees M, Solam SGH (1957) A simple method for the isolation and purification of total lipides from animal tissue. Journal of Biological Chemistry 226: 497-509.
21. Mukhopadhyay PK, Rangacharyulu PV, Mitra G, Jana BB (2003) Applied Nutrition in Freshwater Prawn, *Macrobrachium rosenbergii* Culture. Journal of Applied Aquaculture 13(3-4): 317-340.
22. Walkley A, Black IA (1934) An examination of the Degtjareff method for determining organic carbon in soils: Effect of variations in digestion conditions and of inorganic soil constituents. Soil Science 63: 251-263.

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